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THE OTTAWA MEETING OF THE AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE

Edited by **Dr. F. R. MOULTON**

PERMANENT SECRETARY

OTTAWA WAS HOST

As was anticipated, the arrangements for the meeting at Ottawa from June 27 to July 2, inclusive, were excellent. Efficient local committees provided for every requirement from finances and meeting places to boy scouts to serve as messengers. There was a fine combination of attention to business details, preparation for scientific sessions, provision for social diversions and a warm spirit of hospitality to visitors. Moreover, the weather was perfect. Ottawa, the capital city of Canada, was indeed host to the association, and those who attended the meeting will long remember it as a delightful occasion.

That the association is American in the broad sense of the word could not be better illustrated than it was at Ottawa. The meeting was not international; it was simply American. The science was not Canadian or United Statesian; it was just science, even though the subject was some geological or biological problem of one or the other of the countries. There was no fine balancing of chairmanships and positions on committees as there is in meetings colored by political considerations. Science was the order of business, and it was conducted in the spirit of perfect harmony and good fellowship.

And why shouldn't a meeting of the association be wholly free from all considerations of national boundaries? Science is not sectional nor limited to any people. Throughout its history its heroes have appeared in every civilized land, and they have spoken every tongue. The mere fact that I feel it is appropriate to mention these things is a commentary on the low level at which the relations among peoples now largely exist. In the world as a whole the rule of tooth and claw prevails. Perhaps science will be able to initiate an age of reason; certainly the Ottawa meeting tended in that direction.

In order to promote interest in science as widely as possible throughout America, the association holds its meetings in various cities in the United States and Canada. For example, the summer meeting two years ago was held in Rochester, N. Y., and the meeting last summer was held in Denver, Colo. It is hoped that the meeting in Ottawa will add a great impetus to science in Ontario, and indeed throughout Canada. Canadian science has had a distinguished history, as was excellently demonstrated in the symposium on "History of Science in Canada," which was organized and presented by the Section on the Historical and Philological Sciences. Perhaps the Ottawa meeting will mark the close of one period in Canadian science and the beginning of a new one. By a happy coincidence, the council, by unanimous action, voted to admit the British Columbia Academy of Sciences to the relationship of an affiliated society of the association. There are now 31 affiliated academies of science, only one of which is Canadian.

SOME STATISTICAL INFORMATION

From its organization in 1848 until 1902 the association held its meetings, one each year, in the summer, usually in August. Beginning with 1902, the time of the meetings was changed from the summer to the last week in December, including occasionally the first days of January. These winter meetings are the annual meetings of the association. In August, 1915, a summer meeting was held in San Francisco, Calif., in connection with the organization of the Pacific Division. In June, 1922, a summer meeting was held in Salt Lake City, Utah, and in September, 1923, one was held in Los Angeles near the time of a total eclipse of the sun, which was visible from southern California and northern Mexico. In June, 1925, two summer meetings were held, one in Boulder, Colo., in connection with the Southwestern Division, which was organized in 1920, and one in Portland, Oregon, in connection with the Pacific Division. Since 1931 the association has regularly held summer meetings.

In comparing statistics of meetings of the association, it should be remembered that in earlier years only one meeting was held each year, whereas there are now two. The annual December meeting has been by far the larger of the two, with the exception of the Chicago meeting in June, 1933, in connection with the Century of Progress Exposition.

Canada has been host to the association in five meetings: Montreal, 1857 and 1882; Toronto, 1889 and 1921; and Ottawa, 1938. The first four were regular annual meetings of the association; the last, a summer meeting. Some of the principal statistics relating to the five meetings held in Canada are:

	1857	*1882*	*1889*	*1921*	*1938*
Members	953	1,407	1,956	11,547	19,307
Registrations	351	937	424	1,832	1,104
Papers	132	255	211	900	466

As has been stated, the statistics for the Ottawa meeting are not comparable with those of earlier years. Perhaps a better comparison would be obtained by combining the figures for the Indianapolis and the Ottawa meetings. For the two meetings together, the number of registrations was 4,198 and the number of papers (including 25 invited discussions) was 2,147.

The registrations at Ottawa were as follows: Alberta, 16; British Columbia, 10; Manitoba, 10; New Brunswick, 17; Nova Scotia, 16; Ontario, 543 (Ottawa, 373); Quebec, 125; Saskatchewan, 16; Prince Edward Island, 2 (total for Canada, 755); Newfoundland, 2; Alabama, 2; California, 5; Connecticut, 14; District of Columbia, 44; Illinois, 16; Indiana, 1; Iowa, 4; Kansas, 2; Louisiana, 1; Maine, 10; Maryland, 3; Massachusetts, 24; Michigan, 15; Minnesota, 7; Missouri, 7; Montana, 1; New Hampshire, 6; New Jersey, 14; New York, 98; North Carolina, 4; North Dakota, 2; Ohio, 13; Oklahoma, 2; Pennsylvania, 20; Rhode Island, 3; South Carolina, 2; Tennessee, 5; Utah, 1; Vermont, 1; Virginia, 6; West Virginia, 3; Wisconsin, 8 (total for United States, 338); Australia, 3; England, 2; Germany, 1; Scotland, 1; South Africa, 1; Sweden, 1.

There were 81 scientific sessions at the Ottawa meeting in addition to 11 field trips, most of which were scientific sessions in a different form, and 9 dinners and luncheons. The sessions were held in 25 rooms, all of which were in use on Wednesday morning. Of the 81 sessions for the reading of papers, 25 were devoted to the 18 symposia which were presented at the meeting. There were in addition 7 round-table discussions.

GENERAL SESSIONS

On Wednesday evening, June 29, Dr. Robert C. Wallace, principal and vice-chancellor of Queen's University, Kingston, Ontario, delivered the seventh Maiben lecture on the subject, "The Changing Values of Science." An audience that filled the large auditorium of Lisgar Collegiate Institute listened with rapt attention to Dr. Wallace's inspiring address.

The other general sessions of the Ottawa meeting were the four programs on "Science and the Future" which were organized and presented by the Section on the Social and Economic Sciences. The speakers at the first session were Dr. Stuart Rice, director of U. S. Central Statistical Bureau, whose subject was "World Standards of Living," and Mr. F. E. Lathe, of the National Research Council of Canada, whose subject was "World Natural Resources." At the second session, Dr. William Crocker, director of Boyce Thompson Institute for Plant Research, spoke on "The Botanical Sciences and the Future," and Dr. Frank R. Lillie, president of the National Academy of Sciences, spoke on "The Zoological Sciences and the Future." The third session was devoted to the physical sciences, Dr. Arthur H. Compton, of The University of Chicago, speaking on "Physics and the Future," and Dr. Harold C. Urey, of Columbia University, on "Chemistry and the Future." In the final session concrete applications of science to producing material things used and useful in the world were discussed by the heads of two great industrial laboratories, Mr. M. W. Smith, of the Westinghouse Electric and Manufacturing Company, and Dr. John Johnston, of the United States Steel Corporation. The subject of Mr. Smith was "The Application of Science to the Electrical Industry" and that of Dr. Johnston was "The Application of Science to the Metallurgical Field."

In all these discussions there were notes of triumph because of remarkable past achievements and expressions of confidence for the future, mingled as never before with feelings of responsibility for the welfare of society. One could not hear the brilliant addresses of these programs without feeling that the epics of our day are being written in the fields of science. It was particularly fortunate that the heads of two great industrial laboratories participated in the discussions, for it will be advantageous for scientists in general to learn how little difference there is between the science of industries and that of the somewhat secluded laboratories of universities. It will be advantageous, too, for university scientists to learn of the breadth of view and the sense of social responsibility of workers in industrial laboratories. And it will perhaps be surprising to representatives of industry to learn that the association is taking a deep interest in the fundamentals on which the industrial and economic life of the world depends.

SYMPOSIA

Including the "Science and the Future" program, which has just been mentioned, 18 symposia were organized and presented at Ottawa. In the order in which they appeared in the General Program of the meeting they are:

1. *Medical Biochemistry* (Section on Chemistry and Section on Medical Sciences. Dr. Harold C. Urey, chairman). "Hormones and Immunity" was discussed by Dr. W. R. Franks and Sir Frederick G. Banting; "Bio-electric and Other Physiological Responses of Insulin and Metrazol," by Drs. J. E. Goodwin, G. E. Hall, B. Leibel and D. P. C. Lloyd; "The Prolongation of the Action of Insulin," by Dr. Albert Fisher; "The Purification of Heparin," by Dr. Arthur Charles; "The Ketogenic and Anti-Insulin Properties of Anterior Lobe Extracts," by Drs. A. H. Neufeld and J. B. Collip; and "Studies on the Specific Metabolic Stimulant of Pituitary Extracts," by Drs. D. K. O'Donovan, O. F. Denstedt and J. B. Collip.

2. *The Nutrition Problem in North America* (Section on Chemistry. Dr. Harold C. Urey, chairman). "Physiological Functions of the Vitamins" was discussed by Dr. E. W. McHenry; "Determination of the Vitamin, Iron and Calcium Requirements of the Human," by Dr. Frederick F. Tisdall; "The Standardization of the Vitamin Content of Cod Liver Oil," by Drs. W. D. McFarlane and A. R. G. Emslie; "Maximum Efficiency with Minimal Diets," by Dr. I. M. Rabinowitch; "Evaluation of Canadian Feeding Stuffs," by Dr. C. J. Watson; "The Role of Pasture in Animal Nutrition," by Dr. E. W. Crampton; "Simplified Diets in Poultry Nutrition," by Dr. H. D. Branion; and "Effect of Diet and Other Factors on the Composition of Fat in the Bacon Hog Carcass," by Dr. R. D. Sinclair.

3. *The Application of Isotopes to Biochemical Problems* (Section on Chemistry and Section on Zoological Sciences. Dr. Harold C. Urey, chairman). "The Concentration of Isotopes" was discussed by Dr. H. G. Thode; "The Use of the Nitrogen Isotope for Biological Studies," by Dr. Rudolf Schoenheimer; "The Application of Deuterium to Intermediate Metabolism," by Dr. David Rittenberg; and "Pharmacological and Toxic Effects of Deuterium Oxide," by Dr. Henry G. Barbour.

4. *Atmospheric Ozone and Measurement of Ultra-Violet in Solar Radiation* (Section on Astronomy and Royal Astronomical Society of Canada). "Atmospheric Ozone as a Constituent of the Atmosphere" was discussed by Dr. B. Haurwitz; "Ozonosphere Temperatures under Radiation Equilibrium," by Dr. E. H. Gowan; "Atmospheric Ozone as related to Meteorology," by Dr. Chaim Pekeris; and "The Determination of Atmospheric Ozone from the Measurement of Ultra-Violet Solar Radition," by Dr. Brian O'Brien.

5. *The Migration of Salmon—and Conservation.* (Section on Zoological Sciences and Ecological Society of America. Dr. A. G. Huntsman, chairman). "The Atlantic Salmon of Europe" was discussed by Mr. W. J. M. Menzies, of Edinburgh, Scotland; "The

Pacific Salmon of Alaska and the Western States," by Dr. W. H. Rich; "The Pacific Salmon of British Columbia," by Dr. W. A. Clemens; "The Atlantic Salmon of the Gulf of St. Lawrence," by Dr. D. L. Belding; "The Atlantic Salmon of Nova Scotia and New Brunswick," by Dr. A. G. Huntsman; and "Factors Controlling Salmon Migration," by Dr. Henry B. Ward.

6. *The Relation of Insects to Forest Conservation* (Entomologists, Foresters and Forest Pathologists. Dr. J. M. Swaine, chairman). "Cooperation in Insect Studies Relating to Forest Conservation" was discussed by Dr. J. J. deGryse; "Some Economic Aspects of White Pine Blister Rust Control," by Dr. J. F. Martin; "The Relation of Insects and Other Biotic Factors to the Development of the Modern Forest," by Dr. S. A. Graham; "The Relation of Insects to Rehabilitation Plantations in Drought Areas," by Dr. N. D. Wygant; and "The Relation of Insects to the Conservation of Farm Woodlots," by Dr. R. B. Friend.

7. *The Genetics of Pathogenic Organisms. Viruses, Protozoa, Bacteria and Fungi Pathogenic to Plants.* (Section on Botanical Sciences, Section on Medical Sciences, Section on Agriculture, American Phytopathological Society and Genetics Society of America). *Viruses:* "Viruses Pathogenic to Animals" was discussed by Dr. E. A. Watson; and "Viruses Pathogenic to Plants," by Dr. L. O. Kunkel. *Protozoa:* "Genetics of the *Parasitic Protozoa*" *was discussed by Drs.* W. H. Taliaferro and C. G. Huff; and "The Influence of Host Constitution on the Parasite," by Dr. C. G. Huff. *Bacteria:* "Some Problems in the Genetics of Bacteria Pathogenic to Man" was discussed by Dr. G. B. Reed; "Some Examples of Hereditary and Environmental Influence on Bacterial Pathogenicity," by Dr. H. Konst; and "Genetics of Bacteria Pathogenic to Plants," by Dr. A. J. Riker. *Fungi Pathogenic to Plants:* Under the general title "The Origin of Parasitic Races of Phytopathogenic Fungi" there were the following four papers: "Origin through Adaptation," by Dr. D. Riddick; "Origin through Hybridization—in Smut Fungi," by Dr. H. A. Rodenhiser; "Origin through Hybridization—in Rust Fungi," by Dr. J. H. Craigie; and "Origin through Mutation," by Dr. J. J. Christensen.

8. *Micro-elements and Deficiency Diseases* (American Phytopathological Society and American Society of Plant Physiologists). Under the general title "Micro-elements in Nutrition of Plants" there were the following three papers: "Review of Literature," by Drs. M. B. Davis and E. P. Grant; "Micro-element Studies at Experimental Farm" (illustrated), by Drs. W. Ferguson and L. E. Wright; and "Microspectrographic Studies," by Dr. G. R. Giles. The remaining papers were as follows: "Spectrographic Analysis Applied to Trace Elements," by Dr. J. S. Foster; "Some Relations of Micro-elements to Animal Life," by Dr. E. J. Underwood; "Boron Deficiency Symptoms in Agricultural Plants in British Columbia," by Dr. H. R. McLarty; "Cytology of Deficiency Diseases with Special Reference to Boron," by Dr. J. Coulson; "Thallium Toxicity," by Dr. E. L. Spencer; and "Permeability of Host Cells in Relation to Fungus Parasites," by Dr. F. S. Thatcher.

9. *Phytogeographical Problems of Northeastern Canada* (Section on Botanical Sciences, Botanical Society of America and American Society of Plant Taxonomists. Dr. M. L. Fernald, presiding). "Botanical Evidence of a Post-pleistocene Marine Connection Between *Hudson* Bay and the St. *Lawrence Basin*" was discussed by Dr. David Potter; "The Phytogeographical Implications of the Flora of Northeastern Labrador," by Dr. Ernst C. Abbe; "Some Factors in the Isolation of Rare Plants," by Dr. V. C. Wynne-Edwards; "The Bic Florula and its Bearing on the General Problem," by Dr. Jacques Rousseau; and "The *Mingan-Anticosti Phytogeographical Problem*," by Frère Marie-Victorin.

10. *Root Rots and Seed Borne Diseases* (Canadian Phytopathological Society and American Phytopathological Society. Dr. H. W. Anderson, chairman). "Relation of Plant Pathological Technique to Seed Laboratory Practise" was discussed by Dr. R. Howard Porter; "The Incidence of Pathogenic Fungi in Seeds," by Dr. G. A. Scott; "The Rôle of Infected Seed in the Development of Seedling Blight and Root Rot in Cereals," by Dr. J. J. Christensen; "The Soil Microflora and other Factors Affecting the Development of Root Rot," by Dr. F. J. Greaney; "Root Development in Relation to Root Rot Diseases," by Dr. P. M. Simmonds; and "The Interrelation of Organisms to Root Rot," by Dr. G. B. Sanford.

11. *Drought Relations* (American Society of Plant Physiologists and Genetics Society of America). "Xerophytic Plants, their Evolutionary Origin from Mesophytes and their Possible Utilization in Culture or as Plant Breeding Material" was discussed by Dr. Walter T. Swingle; "Studies on the Physiology of Drought Resistance in Cereals," by Dr. A. G. O. Whiteside; "Similarities between Drought and Frost Resistance," by Dr. J. Levitt; "Water Absorption as a Factor in Drought Injury," by Dr. Paul J. Kramer; "Water Economy of Trees in Relation to Drought," by R. D. Gibbs; "Effect of Cultivation on Soil Moisture Relations," by Drs. W. J. Staple and J. Lehane; "Comparative Development of Drought Resistant Wheat Varieties under Varying Moisture Supply," by Dr. J. W. Hopkins; "Root Studies of Weed and Crop Plants," by Drs. T. K. Pavlychenko and L. E. Kirk; "The Problem of Breeding Wheat for Resistance to

Drought," by Dr. K. W. Neatby; "Triticum-Agropyron Hybrids for Drought Areas," by Drs. F. H. Peto and L. V. P. Johnson; and "The Influence of Moisture Supply on the Drought Resistance of Pine Seedlings," by Dr. Hardy L. Shirley.

12. *Science and the Future* (Section on Social and Economic Sciences). Program was discussed under the heading "General Sessions."

13. *The Influence of Fire on Forests, Wild Life and Public Welfare* (American Association, Ecological Society of America, Society of American Foresters and Canadian Society of Forest Engineers. Dr. C. C. Adams, presiding). "Fire and Forests" was discussed by Dr. Irvine T. Haig; "Fire and Wild Life," by Dr. Hoyes Lloyd; and "Fire and Land Use," by Dr. Herbert C. Hanson.

14. *The Present Status of the Psychology of Thinking* (Section on Psychology. Dr. George Humphrey, chairman). Under the general title of the symposium, three comprehensive papers were presented, after which there were discussions by invited speakers. Dr. George Humphrey discussed the history and development of this field in scientific psychology; Dr. N. R. F. Maier reported on animal and human experiments on the nature of reasoning; and Dr. S. N. F. Chant described recent experiments which separate analogical and analytical processes in reasoning.

15. *History of Science in Canada* (Section on Historical and Philological Sciences). "The Advance of Physics in Canada" was discussed by Dr. A. Norman Shaw; "The Beginnings of Chemistry in Canada," by Dr. W. Lash Miller; "Canada's Contributions to Botany," by Frère Marie-Victorin; "The History of Zoology in Canada," by Dr. J. R. Dymond; "The History of Geology in Canada," by Dr. Frank D. Adams; "The Growth of Astronomy in Canada," by Dr. W. E. Harper; "An Outline of the Progress of Mathematics in Canada," by Dr. Samuel Beatty; "Medical Research during the French Régime," by Dr. L. E. Pariseau; and "Why the Social Sciences Lag behind the Biological and Physical Sciences," by Dr. Joseph Mayer.

16. *Bacillus Calmette-Guérin* (B.C.G.) (Section on Medical Sciences). "B.C.G. Vaccine, Eleven Years' Experimental Work on Its Innocuity and Efficacy" was discussed by Dr. A. Frappier; "B.C.G. Vaccination of Cattle and Resistance to Tuberculosis," by Dr. E. A. Watson; "The Immunizing Properties of B.C.G. Vaccine in Bovines," by Dr. Allan C. Rankin; "Vaccination of Indian Children with B.C.G., Progressive Report," by Dr. R. G. Ferguson; "Twelve Years' Experience with B.C.G. Vaccine at the University of Montreal," by J. A. Baudouin; and discussion led by Dr. Wm. H. Park.

17. *Progress of Swine Improvement in Canada* (Canadian Society of Technical Agriculturalists and Canadian Society of Animal Production). "Advanced Registry for Pure-bred Swine" was discussed by Dr. A. W. Peterson; "Test Station Operation," by Dr. R. G. Knox; "Discussion of the Results of Station Testing in Canada," by Dr. J. G. Lefebvre; "Analysis and Interpretation of Carcass Results," by Dr. E. W. Crampton; "Discussion of Recent Investigations in Carcass Evaluation," by Dr. J. G. Stothart; and "Market Quality of Canadian Bacon," by Dr. L. W. Pearsall.

18. *Comparison of Nutritive Value of Pasture and Hay with Other Crops* (American Society of Agronomy. Dr. O. McConkey, presiding). "Problems in Evaluating Pastures in Relation to Other Crops," by Drs. H. L. Ahlgren, G. Bohstedt and O. S. Aamodt; "Comparative Cost of Total Digestible Nutrients in Pasture and Other Crops," by Drs. E. S. Hopkins and P. O. Ripley; "Seasonal Variations in Chemical Composition of Pasture, Hay and Grain from Different Regions in Ontario," by Dr. N. J. Thomas; "Relative Values of Alfalfa Hay and a Mixture of Concentrates for Milking Cows," by Dr. T. E. Woodward; "Methods of Evaluating Live Stock Feeds," by Dr. F. B. Morrison; "Remarks on Evaluation of Herbage and Pasture," by Dr Paul E. Howe; and "Some Problems in the Determination of the Nutritive Value of Pasture Herbage," by Dr. E. W. Crampton.

A number of programs listed as round-table conferences did not differ greatly in their general plan from some of the symposia. Others were somewhat informal discussions of closely related subjects. The programs of several of the sections and societies were thoroughly organized in subject-matter, yet were not designated either as symposia or round-table conferences. For example, the Section on Geology and Geography had six sessions, each on a different well-defined field of geological interest. Since the council at the Indianapolis meeting last December authorized the publication by the association of such symposia as the executive committee may approve of, a clear formulation of the conditions under which a program should be designated as a symposium becomes important. Such a formulation is also important in preparing a balanced report of a meeting of the association. Perhaps the subject should be discussed and a definition given of the word symposium at the Secretaries' Conference at the Virginia meeting next December.

BUSINESS ITEMS

AT its first meeting on Monday, June 27, the council appointed Dr. Wesley C. Mitchell, president of the association, Dr. George D. Birkhoff, the retiring president, Dr. F. R. Moulton, the permanent secretary, Dr. Earl B. McKinley, member of the executive committee, Dr. Herbert E. Ives, vice-president of the association and chairman of the section on physics, Dr. H. G. Moulton, formerly vice-president of the association and chairman of the Section on Social and Economic Sciences, to represent the association in discussions with representatives of the British Association for the Advancement of Science, at its Cambridge meeting in August, on the question of closer cooperation between the two associations and of other subjects of mutual interest.

At the same session the council adopted the following resolution:

WHEREAS: The American Association for the Advancement of Science, realizing the fact that the holding of international congresses or meetings for the purpose of discussing science and human welfare servers fundamentally to advance understanding among the nations, hereby approves in principle lending its influence and support to further the plans of such congresses or meetings when arranged or sponsored by any of its affiliated societies or by other organizations of corresponding standing.

The permanent secretary reported that the total membership of the association on June 21 was 19,307; on June 22, 1937, it was 18,353. Between the beginning of the fiscal year, October 1, 1937, and June 21, 1938, the names of 1,925 new members had been added to the rolls of the association; the estimate made last October for the number of new members that would be added in the entire year was 1,300.

The permanent secretary reported that 23 broadcasts were delivered between January 19, the date of the first broadcast of the series, and June 27, and that in response to written requests for copies of the scripts 143,400 had been sent out to listeners.

In response to a request from the World Education Federation, the council appointed Dr. Otis W. Caldwell, general secretary, and Mr. H. A. Carpenter to organize the program of the Science Section meetings of the Federation to be held in Rio de Janeiro, Brazil, in the summer of 1939.

The council appointed Colonel C. F. Craig, Tulane University Medical School, New Orleans; Dr. Mark F. Boyd, Rockefeller Institute for Medical Research, New York, and Dr. Louis L. Williams, U. S. Public Health Service, Washington, as a supervisory committee for the development of a three-year program on malaria, closing with a comprehensive symposium on the subject at the meeting in December, 1941.

For the purpose of increasing the service of the association to its affiliated academies of science, the council passed the following resolution:

Resolved, that the officers of the Association be authorized and instructed to offer to each of the affiliated Academies of Science the privilege of nominating for annual Honorary Junior Membership in the Association one boy and one girl from its junior academy or, if it has no junior academy, from junior science clubs within its territory; and that the Association in thus providing for Honorary Junior Memberships shall arrange so that during the period of honorary membership the honorary junior member shall pay no entrance fee or dues, shall receive a suitable certificate of membership, the copies of SCIENCE containing the preliminary announcements and the reports of the meetings, the programs of the meetings; and also Science News Letter, provided through the courtesy of Science Service.

The Committee on the Theobald Smith Award in Medical Sciences reported its selection of Dr. Charles F. Code, of the Mayo Foundation, Rochester, Minn., as the second recipient of the $1,000 award for his work on "Histamine in the Blood." The report was unanimously accepted by the council. The secretary of the Section on Medical Sciences was appointed to be secretary of the Theobald Smith Award Committee in Medical Sciences.

Dr. J. F. Dashiell, of the University of North Carolina, Chapel Hill, N. C., was elected by the council as vice-president of the association and chairman of the Section on Psychology.

Dean Edward Spease, of Western Reserve University, Cleveland, Ohio, was appointed a member of the executive committee of the Subsection on Pharmacy.

The council by unanimous vote accepted the British Columbia Academy of Sciences as an affiliated academy of the association. This is the first Canadian academy to be admitted as an affiliated academy. The number of scientific societies, academies and organizations now affiliated or associated with the association is 166.

Just before its final adjournment on June 30, the council, in appreciation of the courtesies extended to the association by the citizens of Ottawa and of Canada, unanimously adopted the following resolution:

The American Association for the Advancement of Science and its affiliated societies hereby express their deep appreciation to the citizens of Ottawa and of Canada for acting as hosts to the One Hundred-Second Meeting of the Association, which was held in Ottawa, Ontario, from June 27 to July 2, 1938, inclusive. At this meeting there were more than 100 scientific sessions before which nearly 500 papers were presented. The registered attendance exceeded 1,100, which ranks the Ottawa meeting among the largest summer meetings the Association has held.

Not only has the Ottawa meeting been exceptional in point of attendance and in number of scientific papers presented, but as the result of the work of a splendid Local Committee provisions for its scientific sessions and for the entertainment of members and their guests have been ideal. His Excellency, Lord Tweedsmuir, was Patron of the Meeting; Senator Raoul Dandurand, Honorary

Chairman of the Local Committee; Dr. C. Camsell was Chairman of the Local Executive Committee; Drs. A. Beauchesne and R. W. Boyle were Vice-Chairmen, Drs. A. Lanctot and H. M. Tory were Executive Members; and Mr. H. L. Trueman was Secretary. To the special Committee Chairmen, N. C. Allen, Finance; E. Rhoades, Publicity; F. E. Lathe, Program; T. A. McElhanney, Equipment; L. S. McLaine, Registration; C. H. Bland, Staff, and M. F. Gregg, Entertainment, the Association owes especial thanks for the great success of the meeting. Moreover, the Boy Scouts of Canada, alert and ever ready for action, rendered varied and effective services that helped make the machinery of the meeting function smoothly. All visitors will long hold pleasant memories of Ottawa as a delightful city and of its inhabitants as ideal hosts.

The meeting that was held this week is the fifth meeting of the Association in Canada, for the Association is American in the broad sense of the word. In science on this continent national boundaries are of no consequence. The participants in this meeting considered together in harmony and good will more fundamental things than political rivalries. If the spirit of this meeting extended throughout the world, many of the troubles that now afflict mankind would not exist.

The daily papers of Ottawa and of Canada, with fine discrimination of what is important and in the sincere spirit of science, have given this meeting a great deal of publicity. The Canadian Broadcasting Corporation has carried a number of broadcasts. In fact, from the very beginning of the preparation for this meeting to its close, the citizens and institutions of Ottawa and of Canada rendered services to the Association and its affiliated societies which the Council here gratefully but inadequately acknowledges.

SCIENTIFIC SESSIONS

SECTION ON PHYSICS (B)

(From report by Henry A. Barton)

Section B held three sessions, at which 16 papers were read, Herbert E. Ives, chairman of the section, presiding. The program, arranged by J. A. Gray, of Queen's University, Ontario, was unusually strong for a summer meeting. Visiting physicists enjoyed the opportunity of visiting the National Research Laboratories, in which the scientific sessions of the section were held.

The first session consisted of four short papers on such miscellaneous subjects as low frequency currents, specific heats of gases and applications of spectrophotometry to blood pigments, and a special paper by H. E. Ives on "The Unsymmetrical Doppler Effect in Hydrogen Canal Rays and its Significance in Optical Theories." Using canal ray tubes of the type devised by Dempster, Ives found that the displacement of spectral lines was exactly the amount predicted by the Larmor-Lorentz theory, according to which a moving clock runs slow. The next session consisted of three invited papers on sound, two on ultrasonic waves. F. H. Sanders presented a paper on "Passage of Ultrasonic Waves through Thin Plates," and R. W. Boyle presented one on "Ultrasonics—Marine Applications." The third paper, by H. E. Reilley, was on "Noise Abatement Problems in Canada." At the final session 8 short papers were read.

SECTION ON CHEMISTRY (C)

There were five sessions of the Section on Chemistry, the third of which was a joint symposium with the Section on Medical Sciences on "Medical Biochemistry" (item 1 under Symposia) and the fifth of which was a joint symposium with the Section on Zoological Sciences on "The Applications of Isotopes to Biochemical Problems" (item 3 under Symposia). The fourth session was devoted by the section to a symposium on "The Nutrition Problem in North America (item 2 under Symposia). The first session consisted of three papers on "Gas Reactions" and the second of six papers on miscellaneous subjects ranging from physical and chemical aspects of textile fibers to the refining of radium ores. A total of twenty-seven papers were presented before the section.

SECTION ON ASTRONOMY (D) AND ROYAL ASTRONOMICAL SOCIETY OF CANADA

(From report by Harlan T. Stetson)

The section and the Royal Astronomical Society of Canada held three sessions, the first two of which were general sesssions, and the third of which was a symposium on "Atmospheric Ozone and Measurement of Ultra-violet in Solar Radiation" (item 4 under Symposia). A total of thirty papers was presented. At the first session W. E. Harper, in his discussion of "Fifty Years of Astronomical Work in Canada," outlined the remarkable progress of astronomy in Canada from the days in which a small transit was the only official observing instrument to the present great 72-inch reflector at Victoria, B. C., and the 74-inch reflector at the David Dunlap Observatory. The remainder of the program included a wide range of subjects—the relation of terrestrial phenomena to the solar cycle; sunspot influence on the tree growth in Canada with correlations opposite in sign for the coastal regions from those for the interior; statistics on distribution of sunspots in longitude; a spectroscopic attempt to determine whether the greenish areas on Mars owe their color to vegetation, a negative conclusion being indicated; navigation near the pole; variable stars in globular clusters; orbits of spectrographic binary stars; solar rotation measurements; and radial velocities of certain stars.

SECTION ON GEOLOGY AND GEOGRAPHY (E) AND THE GEOLOGICAL SOCIETY OF AMERICA

(From report by Howard A. Meyerhoff)

The section held two sessions, one of five papers on "Regional Geography" and one of five papers on "Geographic Problems of the Northern Frontier," and four joint sessions with the Geological Society of America, the general subjects of which were "Physiography," "Aspects of the Mineral Industry," "Precambrian Economic and Stratigraphic Geology" and "Precambrian and Paleozoic Geology." In addition to the six formal sessions, several field trips were arranged, one of two and one-half days under the guidance of Morley E. Wilson to examine the Precambrian geology in the Madoc District; one to the laboratories of the Bureau of Mines; another, under the leadership of Dr. Alice Wilson, stratigraphically upward through the Paleozoic section of the Ottawa Lowland; and another, under D. A. Nichols, on physiography and geography, including an inspection of local pulp and power operation. Not satisfied with the six days allowed for the regular meetings and excursions, thirteen members of the section and its affiliated society extended their activities from July 2 to July 7 by a trip, arranged by Dr. Timm, director of the Bureau of Mines, and under the guidance of Mr. Parsons, to the Hollinger, McIntyre, Dome, Noranda, Wright-Hargreaves and other mines. The great success of the scientific sessions and the excursions, in which ninety persons participated at least in part, was due largely to Walter A. Bell and other Canadian geologists.

SECTION ON ZOOLOGICAL SCIENCES (F) AND AFFILIATED SOCIETIES

The Section on Zoological Sciences presented a symposium on "The Migration of Salmon—and Conservation" (item 5 under Symposia), a joint symposium with the Section on Chemistry on "The Application of Isotopes to Biochemical Problems" (item 3 under Symposia) and a joint program with the Ecological Society of America.

The American Association of Economic Entomologists, the Entomological Society of America and the Entomological Society of Ontario held a symposium under the chairmanship of J. M. Swaine on "The Relation of Insects to Forest Conservation" (item 6 under Symposia) and three joint sessions at which twenty-three papers were read. At the first session, under the chairmanship of Arthur Gibson, such varied subjects were considered as wireworms of Canada, wind drift and dissemination of insects, ticks as vectors of animal diseases and methods of estimating the populations of insects in a field. Before the second session, with A. L. Melander serving as chairman, papers were read on a variety of subjects, including "Increasing Demands upon Entomologists," "The Male Genitalia of Insects," "Thirty Years' Experience with Orchard Sprays in Nova Scotia," "Synthetic Compounds that Look Promising as Insecticides," "Ephemerid Coloration and Its Relation to the Time of Emergence" and "Insect Life as Recorded by the Motion Picture Camera." Dr. J. J. Davis was chairman of the final session before which nine papers were presented on such subjects as "The European Sawfly in Eastern Canada," "An Economic Appraisal of Grasshopper Outbreaks and Control in Saskatchewan; a Progress Report" and "Biological Control of Insects through Plant Resistance."

SECTION ON BOTANICAL SCIENCES (G) AND AFFILIATED SOCIETIES

(*From reports by J. T. Buchholz, D. B. O. Saville and M. J. Adams*)

The societies presenting programs in the field of the botanical sciences were the Canadian Phytopathological Society, the American Phytopathological Society, the American Society of Plant Physiologists, the Botanical Society of America and the American Society of Plant Taxonomists. The section held a joint symposium with the Botanical Society of America and the American Society of Plant Taxonomists on "Phytogeographical Problems of Northeastern Canada" (item 9 under Symposia). The section also held a session for the presentation of general papers, with Frère Marie-Victorin presiding. The program included ten papers. R. B. Thomson presented two illustrated papers. Phyllis Cook compared the oriental and occidental species of Thuja; J. T. Buchholz made an embryological comparison of two species of Sequoia. Jules Brunel gave an account of a most interesting study of the Desmid flora of a recent peat bog from a study by Frère Irenne-Marie, which disclosed, from samples taken at all times of the year, thousands of species of these microscopic plants. A. H. Hutchinson described a polygonal method of graphing ecological data by which the relationships of many complex variables affecting the environmental relationships of plants may be more adequately represented for comparison.

The sessions of the American Phytopathological Society took the form of three symposia held in cooperation with other groups. The first of these, entitled "The Genetics of Pathogenic Organisms" (item 7 under Symposia), was held with the sections on the Botanical Sciences, Medical Sciences and Agriculture and the Genetics Society of America. While discussion of the fungi was limited to plant pathogens and that of the protozoa to animal pathogens, viruses and bacteria were considered in connection with both plant and animal diseases. Of necessity the information presented dealt chiefly with the changes observed in pathogenic organisms and the permanence of such changes, since sexual reproduction and the possibility of true genetic studies is practically confined to the fungi. The close similarity observed in the findings of the workers in the different fields was in itself an argument in favor of such combined sessions. One was left with the impression that in the simpler organisms, where reproduction is at least largely asexual, frequent variations (possibly true mutations) largely take the place of genetic changes brought about by hybridization. The production of new races of pathogens through adaptation to new hosts and through spontaneous variation was described for all types of organisms. New methods of technique have made it possible to separate numerous variants of some of the plant viruses; some of these persist indefinitely without reversion to the original type. Breeding work with the fungi is still in its infancy, but interesting reports on hybridization in the rusts and smuts showed that forms, new in both morphology and pathogenicity, can arise in this way and probably do so in nature; inheritance seems to obey Mendelian principles at least in part.

The second symposium, "Micro-elements and Deficiency Diseases" (item 8 under Symposia), was held in joint session with the American Society of Plant Physiologists. This session was largely concerned with the various disorders, especially in apples and turnips, caused by a deficiency of boron. It was shown that, although boron is now known to be essential to a great many important plants, no use has yet been proved for it in the animal body. Many of these minor elements, even if essential, are toxic if present in more than minute amounts. A disease of tobacco, similar to and perhaps identical with frenching, due to thallium toxicity was given as an example of this fact. Methods of spectrographic analysis for rapid estimation of various elements in plant issue and in soil were described.

The final symposium was held in conjunction with the Canadian Phytopathological Society, the subject being "Root Rots and Seed Borne Diseases" (item 10 under Symposia). Many figures showing the value of seed treatment and the high percentage of fungus infection sometimes found in prize-winning seed samples suggested the advisability of extending the scope of seed testing.

In the discussion of root rots the complexity of studies on this important group of diseases was stressed; the host, pathogen and soil microflora all influence each other.

At the garden party on Tuesday at the Central Experimental Farm, plant pathologists had an opportunity to examine exhibits of the Division of Botany and Plant Pathology of Canada.

Besides joining with the American Phytopathological Society in the symposium on "Micro-elements and Deficiency Diseases," the American Society of Plant Physiologists joined the Genetics Society of America in a symposium on "Drought Relations" (item 11 under Symposia) and in addition had a general program of six papers.

The Botanical Society of America and the American Society of Plant Taxonomists participated with the Section on Botanical Sciences in the symposium on "Phytogeographical Problems of Northeast Canada" (item 9 under Symposia). Papers bearing on the subject were presented by Ernst C. Abbe, V. C. Wynne-Edwards and Jacques Rousseau. In the absence of Frère Marie-Victorin, his paper on the Mingan-Anticosti Flora was presented by Jacques Rousseau. Owing to the absence of David Potter, his paper on a possible floral connection between James Bay and the Ottawa River Valley was not read. The general consensus of opinion was that the "nunatak" theory as a possible explanation of the discontinuity in the distribution of various plant species has been considerably overworked.

After the symposium there was a luncheon for all biologists in the Chateau Laurier, at which a large number of botanists and zoologists were present. The visitors were welcomed in a short address by A. G. Huntsman, of Toronto, to which E. G. Conklin, of Princeton, fittingly responded.

The garden party in the afternoon on the lawn of the Central Experimental Farm was one of the largest and most representative with which Ottawa has been honored. The weather was ideal and the musical program was supplied by the band of the Governor-General's Footguards. In addition to the tents for the catering service, there were two others containing exhibits of the various kinds of scientific work—botanical, entomological, etc.

For the field trips on three successive days typical plant habitats were chosen, the woods surrounding King's Mountain, the sandy soil at Constance Bay and the peat bog at Mer Bleue. In addition to a number of members of the staff of the Division of Botany and the National Herbarium at Ottawa, as well as Toronto University, there were also representatives from Cornell and Harvard Universities, the U. S. Bureau of Plant Industry, the Brooklyn Botanic Garden and the New York Botanic Garden. Scientists were present from states as far apart as Louisiana, Illinois and Maine. On the first trip after the visit to King's Mountain, most of the party traveled up the picturesque Gatineau Valley as far as Wakefield, then along the Lapêche River Valley as far as Masham Mills, and then across country through the hills to Eardley with several stops for the collection of plants. From Eardley the party returned along the base of the mountains to Ottawa, a total distance of about eighty miles. Although the weather turned slightly rainy on the day scheduled for the trip to Mer Bleue, and notwithstanding the fact that it was a national holiday, the excursion was one of the best attended of the three.

ECOLOGICAL SOCIETY OF AMERICA AND GENETICS SOCIETY OF AMERICA

The Ecological Society of America held two joint sessions with the Society of American Foresters and the Canadian Society of Forest Engineers. The first was for the presentation of a symposium on "The Influence of Fire on Forests, Wild Life and Public Welfare" (item 13 under Symposia) and the second was a general program, under the chairmanship of C. F. Korstian, of three papers on forest questions. These societies participated in field trips to Mer Bleue and the Petawawa Forest Experiment Station.

The Genetics Society of America joined with the Sections on Botanical Sciences, on Medicine and on Agriculture and with the American Phytopathological Society in a symposium on "The Genetics of Pathogenic Organisms" (item 7 under Symposia). It also presented jointly with the American Society of Plant Physiologists a symposium on Drought Relations (item 11 under Symposia) and it held a program of eleven cytogenetic demonstration papers.

SECTION ON ANTHROPOLOGY (H)

(From report by Diamond Jenness)

Section H held sessions on three days, at which nineteen papers were presented. The average attendance was eighteen. As was natural at a meeting held in Canada, problems relating to the anthropology and ethnology of that dominion had a prominent place. It was emphasized that prehistoric Canada has played two major roles: (1) that it has offered a home or a passage to ancient peoples migrating from Asia to America; and (2) that it has also been an area of specialization for certain tribes that evolved either within its borders or farther south. T. F. McIlwraith and J. F. Davidson described peculiar features in the religion of two of these tribes, while C. W. M. Hart analyzed the marriage arrangements of a third. Definite cultural links between Asia and America are notoriously hard to establish, but C. M. Barbeau emphasized the close resemblances between the dirge songs of the Northwest coast and old Buddhist chants in China and Mongolia, while Earl Count showed that some folk-lore motifs common to America and Eurasia have apparently stemmed from a common source. Certain writers have ascribed a Siberian origin to the Woodland pottery of eastern Canada and the northeastern United States, but W. J. Wintemberg drew attention to the vast potteryless gap in northern Canada that we must bridge before establishing a connection between the two regions. The vexed question of the origin of the Iroquois was reopened by J. Griffin, who suggested that present archeological and linguistic evidence does not support the hypothesis of a middle Mississippi homeland, and that the Iroquoians may have developed from a Woodland background. D. Leechman described some new discoveries of Dorset Eskimo remains in the Arctic. A very important contribution to the problem of early migration in the Western Hemisphere was made by Junius Bird, who suggested that if the earliest Indians to occupy South America were ignorant of water transport and traveled solely on foot, as seemed to be indicated by his discoveries around the Straits of Magellan, then we should eliminate the Amazon basin from their route and seek their traces in northern Peru along the western side of the Marañon valley.

Three papers dealt with those cultural conflicts and interchanges of primitive with advanced groups that are as important to the practical administrator as to the anthropologist. In the field of physical anthropology, Saunders and Count outlined a new method of graphing dimensions and indices, and J. C. B. Grant described the Stony Indians of Alberta, whose blood-grouping differs quite unaccountably from that of the neighboring Blackfoot. W. M. Krogman offered an outline of the ethnic photohistory of the Near East by stating a chronological sequence of racial types, beginning with the South Europid, which was uniformly present by 4000 B. C. or earlier, the North Europid, which became an important element only in the middle or late 34th millennium B. C., the Central Europid, which came in between 3000 and 2500 B. C., and the Armenoid, which did not appear in Western Asia until about 500 B. C.

At the close of the session several members of Section H accepted the invitation of Dr. C. T. Currelly to visit the Royal Ontario Museum of Archeology in Toronto, whose magnificent Chinese collections had formed the subjects of several papers during the meetings.

SECTION ON PSYCHOLOGY (I)

(From report by Leonard Carmichael)

The Section on Psychology (I) held six scientific sessions from Tuesday to Thursday. Two of these sessions were held jointly with the Section on Education (Q). A dinner for psychologists was held on Wednesday evening under the chairmanship of E. A. Bott, of the University of Toronto. At this dinner, a new Canadian Psychological Association was formed. A detailed announcement concerning the formation of this association, the officers selected, and so forth, will be found elsewhere in SCIENCE.

Probably the most notable part of the scientific session was a symposium (item 14 under Symposia) organized and directed by George Humphrey of Queen's University on the present status of the psychology of thinking. Professor Humphrey himself contributed the first paper of the symposium. He dealt with the history and development of this field in scientific psychology. He pointed out that the subject of thought, technically defined, has received too little attention by professional psychologists in recent years. N. R. Maier, of the University of Michigan, reported on certain animal and human experiments regarding the nature of reasoning which seem clearly to show the distinction between reasoning and memory. S. N. F. Chant, of the University of Toronto, described certain of his recent experiments, which include the separation of analogical and analytical processes in reasoning. After these three major papers, there was a series of brief statements given by those who had been asked in advance to discuss the papers. The second section on social psychology was under the direction of E. A. Bott. The detailed program of papers presented at this session and at the other sessions of the section has been published elsewhere in SCIENCE. This is also true of the joint session with the Section on Education (Q), held under the chairmanship of J. G. Althouse. The sessions on general psychology and learning, under the chairmanship of J. G. Beebe-Center, included a series of theoretical and experimental papers. In one of these papers, Frère Philip, of LaSalle College, Philadelphia, described the application of certain mathematical procedures, first devised for the treatment of earthquake records, to the study of the periodicity of the high-speed continuous work of human subjects. The session on physiological psychology and problems of adjustment was under the chairmanship of Leonard Carmichael, of the University of Rochester. The final session of the program on vocational selection and tests was under the chairmanship of R. B. Liddy, of the University of Western Ontario.

In all, thirty-three major papers were presented before the section. The meetings of the section were held, through the kindness of the authorities of the University of Ottawa, in the lecture rooms of that institution. The programs were marked by excellent discussion, and all in all the meeting of Section I at Ottawa must be considered as one of the most successful summer meetings of the section ever held. To E. A. Bott goes the entire credit for the excellent arrangement of the program.

SECTION ON SOCIAL AND ECONOMIC SCIENCES (K) AND THE AMERICAN STATISTICAL ASSOCIATION

(From the report of Frederick F. Stephan for the latter)

The program of the Section on Social and Economic Sciences consisted of four sessions on "Science and the Future," this being the second conference of a series of five conferences on the general subject "Science and Society." These sessions, held in the auditorium of Lisgar Collegiate Institute, all had the character of General Sessions, described earlier in this report.

The program of the American Statistical Association linked Canadian and American statisticians and economists in a discussion of timely subjects. The program opened with a critical examination of the statistical series that may be used in comparing the fluctuations of economic conditions in Canada and the United States, presented by D. C. MacGregor, of the University of Toronto. In the second paper at the opening session Walter Gardner, of the Board of Governors of the Federal Reserve System, analyzed the influence of the United States on the course of business in Canada, emphasizing monetary and financial relationships between the two countries.

The second session was devoted to a scrutiny of the business outlook with special reference to the effects of government spending. Three speakers participated: Leonard P. Ayres, of the Cleveland Trust Company, Corrington Gill, of the Works Progress Administration, and Courtland Elliott, of A. E. Ames and Company.

Retail and wholesale trade was the subject of the third session. H. Marshall, of the Dominion Bureau of Statistics, discussed the methods and some of the results of the Canadian Census of Merchandising and Service Establishments and the Annual Survey of Retail Trade. The patterns of wholesale and retail trade in Canada and the United States were compared by Vergil Reed, of the U. S. Census Bureau. Willard Thorp, of Dun and Bradstreet, discussed the need for adequate statistics of inventories and business credit and by way of illustration presented a number of points on which current conceptions are at variance with the facts reported in recent studies.

The American Statistical Association joined with the Canadian Agricultural Economics Society and the Canadian Society of Technical Agriculturalists in a session on weather and crop yields. A survey of crop-weather research in the United States was presented by C. F. Sarle, of the Bureau of Agricultural Economics. The relationship between weather factors and wheat yields was discussed with respect to western Kansas by George Montgomery, of Kansas State College, and with respect to western Canada by C. F. Wilson, of the Dominion Bureau of Statistics.

SECTION ON HISTORICAL AND PHILOLOGICAL SCIENCES (L)

(From report by Joseph Mayer)

With the able assistance of Lawrence J. Burpee, of the International Joint Commission, a program was arranged on which eight Canadian scientists presented papers in a two-session symposium on the "History of Science in Canada" (item 15 under Symposia). H. M. Tory presided at the morning session and Joseph Mayer at the afternoon session. The latter delivered the ninth paper, the closing address, on

"Why the Social Sciences Lag Behind the Biological and Physical Sciences."

The papers of the symposium covered the most important scientific advances in Canada from mathematics through biology, some of the developments being illustrated with appropriate lantern slides. The paper on the progress of mathematics in Canada dealt largely with instructional problems and gave examples of examination questions prepared for present-day students and for those of thirty years ago. The advance of physics in Canada was broadly outlined and pictures of modern laboratories and other university facilities were presented. The beginnings of chemistry in Canada were shown with a delightful humor in the presentation of colorful early episodes in chemical progress. The character and work of the scientists who contributed most to the development of botany and zoology in Canada were outlined in some detail. And the growths of Canadian geology and astronomy were likewise well portrayed. Finally, the character of medical research in Canada during the French régime was described in a most interesting manner, and rare manuscripts and books bearing upon this period were exhibited. It is anticipated that these eight papers of the symposium will be printed in one volume under the editorship of Dr. Tory.

SECTION OF ENGINEERING (M) AND INSTITUTE OF AERONAUTICAL SCIENCES

(*From report by Norman Marr*)

The Section on Engineering (M) held one session with four papers on widely diverse subjects. About eighty persons attended this session. The first paper dealt with the collapse of the Falls View Bridge at Niagara Falls during extraordinary ice conditions in the Niagara river in January, 1938. The second paper discussed mining, concentration and transportation operations in connection with mining and treating radium-bearing ores on Great Bear Lake in the sub-Arctic region of northern Canada. The third paper described some instrumental aids to mapping from air photographs as practised in Canada. The fourth paper dealt with some aspects of applied science from the viewpoint of an electrical engineer.

Serving for A. A. Potter as chairman of the section was G. J. Desbarats, immediate past-president of the Engineering Institute of Canada, and Norman Marr, chief hydraulic engineer, Dominion Water and Power Bureau, Department of Mines and Resources, Ottawa, acted as secretary.

The program of the Institute of the Aeronautical Sciences consisted of three sessions, at which nine papers were presented. At the first session I. I. Sikorsky read a paper on "Flying Boats"; T. R. London, one on "Photoelastic Stress Methods"; and G. J. Klein, one on "Snow Performance of Aircraft Skis." The second session consisted of a paper on "Detonation" by C. S. Draper and one on "Aircraft Fuels" by S. D. Heron and of motion pictures of Langley Field with explanatory comments by Lester D. Gardner. The program on aids to flying consisted of the following papers: "The Radiometeorograph," by W. R. Gregg, "Meteorological Services for Trans-Canada Airway," by J. Patterson, and "The Cathode Ray Compass," by J. T. Henderson.

SECTION OF MEDICAL SCIENCES (N) AND SUBSECTION ON PHARMACY

(*From report by Malcolm H. Soule*)

The section on Medical Sciences joined on Monday with the Sections on Botanical Sciences and Agriculture, the American Phytopathological Society and the Genetics Society of America in a symposium on "The Genetics of Pathogenic Organisms" (item 7 under Symposia). More than eighty persons attended each of the two sessions. On Tuesday a symposium was held by the section on "Bacillus Calmette-Guérin (B.C.G.)" (item 16 under Symposia). Wednesday morning the section combined with the Section on Chemistry (C) in a symposium on "Medical Biochemistry" (item 1 under Symposia).

Two papers dealing with the ultraviruses introduced the first symposium. These invisible agents, which in many instances are of molecular dimensions, are generally accepted as living entities. Those that are well known produce specific diseases such as influenza, yellow fever and rabies in animals and tobacco mosaic in plants. As a matter of fact, disease production is the only index of their existence. All agreed that at present little significance can be attached to the genetics of such tiny forms. However, differences in strains of particular viruses are well recognized and changes may be induced by passage through different hosts. In this connection E. A. Watson stated that the same strain of equine encephalomyelitis virus by serial passage through guinea pigs, mice and chick embryos exhibits three strikingly different degrees of virulence, the chick embryo strains being most potent.

Papers dealing with the protozoa, bacteria and fungi pathogenic to plants followed, with a total of eleven contributions. These larger forms may be seen easily under the microscope, and in most instances they give rise to macroscopic growths when cultured on laboratory mediums. All in attendance agreed that there are many problems of mutual interest and that the symposium was of great value in bringing the group together. It was repeatedly emphasized that the plant diseases are superior for experimental work because of the unlimited numbers that may be employed at any one time, the ease of controlling the hosts and the low costs.

The holding of the second symposium at this time and in Ottawa was of particular significance. When Calmette first introduced the Bacillus Calmette-Guérin (B.C.G.) as a prophylactic measure against tuberculosis in France, over fifteen years ago, there was considerable criticism. This technique utilizes a living attenuated culture of the tubercle bacillus. On many occasions it has been pointed out that the viable germ, though apparently harmless, might regain its virulence without warning, and when fed to the infants for purposes of protection might in reality produce active infections with subsequent death. The Canadian investigators undertook to confirm the experiments of Calmette under carefully controlled conditions. A very thorough and ambitious program was projected under the immediate supervision of the Research Council, and experiments in the field of veterinary medicine were included. The data that have been gathered over a period of thirteen years were presented in six papers. Wm. H. Park, of New York City, in discussing the results drew attention to the fact that the figures did not give unequivocal proof that children or calves injected with B.C.G. were solidly protected against exposure to active tuberculosis. There was general concurrence in the opinion that there is no danger attendant with this method provided the organisms are cultured under the conditions originally described. Dr. Park urged that the Canadian workers continue their experiments, for with the passage of time sufficient data will accumulate to permit of more certain conclusions.

Six papers composed the symposium on "Medical Biochemistry." They were by individuals from the medical research institutions at Toronto and Montreal and dealt with the fundamental problems of some of the hormones, particularly insulin and pituitary extracts, as well as the purification of the anticoagulant heparin. Attention was drawn to the possibility that the continued use of insulin by diabetics might elicit the production of neutralizing antibodies and thus render it inert as a reagent for the control of sugar metabolism. These papers only served to emphasize the outstanding achievements of these workers and their continued productivity in the field of medical research.

SECTION ON AGRICULTURE (O) AND AFFILIATED SOCIETIES

(From reports by Henry Clepper, H. G. Crawford, M. F. Morgan, C. D. MacKenzie, J. M. Armstrong and F. S. Browne)

The Section on Agriculture participated with the Sections on Botanical Sciences and Medical Sciences and with the American Phytopathological Society and the Genetics Society of America in the symposium on "The Genetics of Pathogenic Organisms" (item 7 under Symposia).

The second annual summer meeting of the Society of American Foresters was held jointly with the Canadian Society of Forest Engineers, the Association of Forest Engineers of Quebec and the Woodlands Section of the Canadian Pulp and Paper Association. Approximately 150 members of these related organizations were present.

In general, the problems of forestry and related fields were discussed in four principal parts: (1) sessions of interest mainly to foresters and forest engineers and devoted to forest administration, management, classification, research, surveys, reforestation and flood control and silviculture; (2) a joint session with forest entomologists and forest pathologists; (3) two joint sessions with the Ecological Society of America, one of which was a symposium on "The Influence of Fire on Forests, Wild Life and Public Welfare" (item 13 under Symposia); and (4) a field trip to the Petawawa Forest Experiment Station.

The two-day field trip to the Petawawa Forest Experiment Station afforded an opportunity to observe Canadian forest research in silvicultural practices, thinning and improvement cuttings, plantations, and disease, insect and fire control.

In all, twenty-seven papers, supplemented by prepared discussions, were presented by forest workers. Arrangements were made to publish the complete proceedings of the sessions in the October, 1938, issue of the *Journal of Forestry.*

The Canadian Society of Technical Agriculturists, in cooperation with the Canadian Society of Animal Production and the Canadian Agricultural Economics Society, held ten sessions, of which one was a symposium on "Progress of Swine Improvement in Canada," one a round-table discussion by the Engineering Group and one a joint session with the American Statistical Association on the general subject, "Weather and Crop Yields." At the ten sessions fifty-three papers were presented.

The program of the Horticultural Group consisted of miscellaneous papers on horticulture. During the first day the subject of northern horticulture was dealt with by W. D. Albright and E. T. Goring. This subject proved of unusual interest, for most of those present had little or no conception of the achievements in horticulture along the northern limits of civilization on this continent.

A new method for the evaluation of spray materials for apple trees was presented by C. E. Petch, by which the amount of marketable crop, together with vigor and growth of the tree, is used as the measure rather than actual disease and insect control.

In a progress report on the breeding of potatoes for disease resistance, J. L. Howatt stated that very satisfactory progress has been made at the Dominion

Experimental Station, Fredericton, New Brunswick. A large number of highly resistant seedlings has been obtained from the hybridizing of several species, many of which appeared to possess desirable characters for commercial use.

Other papers were presented on storage investigations of tomatoes and celery, weed control in lawns, rootstock and scion relationship of apple trees, nutrient requirements of peaches, rapid soil tests for tobacco soils and cropping practices for flue-cured tobacco.

At the business session Dr. A. F. Barss, of the University of British Columbia, Vancouver, British Columbia, was elected chairman of the group for the year 1938–39, succeeding Dr. C. F. Patterson, of the University of Saskatchewan, Saskatoon, Saskatchewan.

Two sessions of the Canadian Society of Animal Production (Eastern Section), an affiliated body of the Canadian Society of Technical Agriculturists, were held, the former including business, reports and addresses, while the latter was a symposium on "The Progress of Swine Improvement in Canada" (item 17 under Symposia). At the program of the second session, which included six papers, the policy of the Dominion Department of Agriculture with regard to the Advanced Registration of pure-bred swine was outlined, and the several papers included the results of its operation at different centers, relating to progress in breeding, nutritional, carcass evaluation and market quality studies. The papers presented are expected to appear in *Scientific Agriculture* at an early date. The president and secretary-treasurer elected for the forthcoming year are R. G. Knox, Ontario Agricultural College, Guelph, Ont., and C. D. MacKenzie, Central Experimental Farm, Ottawa, Ont., respectively.

The meeting of the Agricultural Engineering Group provided an opportunity for the discussion of farm power and machinery problems in eastern Canada. Discussion on "Mechanical Problems for the Agricultural Engineer" indicated the desirability of combining certain field operations, the development of machines to meet new needs and more extensive testing of equipment over a wide range of conditions. The topic "Tractors for the 100-acre Farm" was also discussed from the angle of individual ownership, hiring of tractor and available work on small farms.

Prospects for "The Small Combine-Harvester in Eastern Canada" were reviewed in the light of recent developments in these machines and farmers' experience with small combines in Ontario in 1937. Under the title "Drying of Forage Crops" the meeting was given an interesting account of the development of a bin-type drier for hybrid seed corn and its adaptability to tray-drying of grass crops. In a paper on "Agricultural Engineering Services in Canada," attention was called to the fact that the farm demand for assistance of an engineering nature is definitely on the increase. Agricultural engineers were urged to attend first to improvements likely to increase production per man as the surest way to increased farm profits.

The meeting of the American Society of Agronomy, with an attendance of 125, was in the form of a conference relative to the evaluation of comparative nutritive value of pasture herbage, hay and other livestock feed crops. Papers presented by O. S. Aamodt, P. E. Howe and T. E. Woodward all brought out the limitations of present standards of comparative evaluation, both on the basis of total digestible nutrients and calorimetric measurements. F. B. Morrison, in an especially stimulating paper based on his classical studies along this line, presented the concept of ***net energy values***. N. J. Thomas discussed the great variations in fattening quality of pasture herbage irrespective of the quantity of feed produced. He suggested that the lignin content may be much more important than the conventional "crude fiber" expression. E. W. Crampton showed that small "pilot" feeding trials with rabbits may be used to facilitate research in determining the nutritive value of pasture herbage.

Steps were taken toward the formation of a joint committee of various organizations interested in standards of measurement in the determinations of nutritive value of pastures and crops.

The Northeastern Section, American Society of Agronomy, with an attendance of about 40, held a brief business meeting, at which officers were elected and a meeting place for 1939 was discussed. The group visited the Dominion Farms on Thursday afternoon.

SECTION ON EDUCATION (Q)

(*From report of J. E. Robbins*)

A major share of the time of the sessions of the Section on Education was given to Canadian problems, twenty-six of the thirty-five papers presented being by Canadian authors. The attendance included representatives from all but one of the nine provincial Departments of Education, and from Newfoundland, thus giving to the discussions a thoroughly representative character. This had a special value for the round-tables on elementary and secondary curricula and for a luncheon meeting which explored the question of establishing a Canadian council on research in education, the central purpose of these meetings being an exchange of views among educators from the widely separated parts of the Dominion. Complete curriculum revisions have recently been made, or are in process of being made, in a majority of the provinces and an opportunity for exchange of experience was welcomed. Reports also of several interesting experiments in curriculum were heard from New York educators.

Dr. H. F. Munro, president of the Canadian Education Association, told the luncheon meeting there was good reason to hope that it would be followed, at the association's biennial meeting in August, by an announcement of the establishment of a Canadian Council for Educational Research, and Mr. C. N. Crutchfield, general secretary of the Canadian Teachers' Federation, pledged the support of the national teachers' organization in the project.

A program on visual education included consideration of the museum as an aid in teaching, as well as the several varieties of projection apparatus that are coming into increasing use in the classroom. A representative of the National Film Society of Canada reported on the society's plans to assist educational authorities, and the Quebec Department of Education gave a demonstration of the use of films, with the assistance of the Associated Screen News of Montreal.

A session on organization and administrative problems in Canadian education included three descriptive papers dealing with Newfoundland, Protestant Quebec and rural Ontario, respectively. A fourth contribution analyzed the relationship of the Dominion Government to education, and a fifth set out a program of teacher-training in the use of visual aids. Two others were statistical studies, one on the sociological consequences of the organization of a large unit of rural administration in Manitoba, and the other summarizing the results of an exhaustive study of data on illiteracy from the decennial census.

Two joint sessions with the Section on Psychology were held, one on child study and pre-school education, the other on vocational selection and tests. The subject-matter of these discussions was less local in character and less concerned with the problems peculiar to Canadian education than in the case of the other sessions, though seven of the thirteen papers were of Canadian origin. Reference to these sessions is also made in the report of the Section on Psychology.

OBITUARY

FRANK LAMSON-SCRIBNER

Frank Lamson-Scribner, who died on February 22, was born in Cambridgeport, Massachusetts, on April 19, 1851. From the time of his earliest recollection he loved the "out of doors" and plants and flowers in particular. This love of nature grew as he grew and as he came to mature years dominated his life. His interests in natural history led him into the fields of higher education. After completing high school he entered the University of Maine, graduating with a B.S. in 1873. In 1920 his Alma Mater conferred upon him, for his distinguished service to science and to agriculture, the degree of LL.D. After completing his undergraduate work at the university he took up school teaching in Maine. In 1877 he was called to Girard College, Philadelphia, where he continued his interest in botany and horticulture in what was then the center of interest in those fields in the United States. He remained there and did notable work until 1885, when he came to the U. S. Department of Agriculture as assistant botanist. He received his appointment as the result of a competitive civil service examination. The department had been organized in 1862, but was just beginning to be recognizd as a promising scientific institution. The botanical work under Dr. George Vasey was soon enlarged to include plant diseases, and Lamson-Scribner became the first chief of that section. His work in that field 1886–1888 is still recognized as standard and as laying the foundations of the great developments that have followed.

As a result of his fine record he was called to the University of Tennessee as professor of botany and horticulture, 1888–1894. He was director of the Experiment Station from 1890 to 1894.

He was called back to the Department of Agriculture in 1894 as chief of a new division, "Agrostology," for the study of forage plants. He did excellent work in developing this field of agricultural science on a basis of practical value to farmers. In 1901 he was selected as chief of the Insular Bureau of Agriculture of the Philippines, where he remained for four years and built up an excellent organization adapted to handle the intricate problems of the agriculture of those islands. Expressions of appreciation of his great services came from the Philippine Government and people and from those in the United States charged with responsibility at that time. After completion of his work, 1904, in the Philippines he returned to the United States Department of Agriculture as special agent and agrostologist from 1904 to 1922.

It was in the early part of this period that he renewed his interests in exhibit work, which began at the history museum at Carlisle, Pennsylvania, 1927–28. He had general charge of the Lewis and Clark Exposition, 1905; Jamestown Exposition, 1907; Alaska Yukon Exposition, 1909; Buenos Aires Centenary Exposition, 1910; U. S. Department of Agriculture, representative Turin Exposition, 1911; member of the U. S. Government Exposition Board, Pan Pacific Exposition, 1915; director of exhibits, U. S. Department of State, Centennial Exposition Rio de Janeiro, 1922–1923; supervisor of U. S. exhibits, Sesquicentennial Exposition, 1926.

His advice and help in organizing the scientific exhibits for agriculture for the Century of Progress Exposition (Chicago, 1933–34) were much appreciated by the writer and by the officers of the exposition.

Dr. Scribner retired from active government service in 1922. He received special honor as Chevalier, Mérite agricole, 1889. He was a member of the New England Botanical Club, Academy of Natural Science, Philadelphia; Buffalo Academy; and was the author of many publications dealing with various aspects of botany and agriculture.

He was an expert photographer and accumulated an invaluable photographic record of the many things of interest with which he came in contact. A recent paper on the Botanic Garden at Rio de Janeiro is illustrated with enlargements of some of these superb photographs. The article is the leading one in the January, 1938, number of *The Scientific Monthly*.

Dr. Lamson-Scribner was "going strong" for more than four score years. He was straight as an arrow, clear of vision and intellect, interested in his work of collecting and writing until the day of his death.

A. F. WOODS

BUREAU OF PLANT INDUSTRY,
U. S. DEPARTMENT OF AGRICULTURE

RECENT DEATHS AND MEMORIALS

DR. ERNEST WILLIAM BROWN, Josiah Willard Gibbs professor of mathematics emeritus at Yale University, died on July 22 at the age of seventy-one years.

DR. JACOB KUNZ, professor of mathematical physics at the University of Illinois, died on July 18 at the age of sixty-four years.

DR. LOUIS K. OPPITZ, professor of physics at McKendree College, Lebanon, Ill., died on July 8 at the age of sixty years.

ARTHUR W. COWLES, who until his retirement last January had been for forty-two years connected with the United States Patent Office, for the last twenty-six years as chief, died on July 21 at the age of seventy-eight years.

A BRONZE plaque in memory of Professor F. B. Peck, formerly head of the department of geology of Lafayette College, was unveiled recently in Markle Hall. The presentation was made by Dr. L. L. Smith, one of Professor Peck's former students, now head of the department of geology at the University of South Carolina. Dr. William S. Hall, emeritus professor of mathematics, read a eulogy, and President Lewis accepted the plaque for the college. The inscription is as follows: "Frederick Burritt Peck, professor of geology, 1897–1925; eminent geologist, inspiring teacher, sympathetic counsellor, exemplary gentleman and lovable character. Erected by his students."

Nature states that the tercentenary celebrations of the birth of James Gregory began at the Royal Society, Edinburgh, on July 4, when papers by Professors H. W. Turnbull, F. Enriques, M. Dehn, E. Hellinger and Dr. O. Prag were presented on his mathematical work. On July 5 a special graduation at the University of St. Andrews was held in the Upper Library Hall, where Gregory had worked and made astronomical observations. Honorary degrees were conferred on Professors G. D. Birkhoff, of Harvard University; A. W. Conway, of University College, Dublin; O. Neugebauer, of the University of Copenhagen; R. Weitzenböck, of the University of Amsterdam, and (*in absentia*) V. Volterra, of the University of Rome. Addresses were received from the Royal Societies of London and Edinburgh, the London Mathematical Society, the Edinburgh Mathematical Society and the Universities of Edinburgh, Cambridge, Paris and from others. An exhibition of books and scientific instruments associated with James Gregory was arranged in the Parliament Hall, Library Buildings, St. Andrews.

SCIENTIFIC EVENTS

UPPER-AIR SOUNDINGS

THE radiometeorograph will replace the airplane in making upper-air soundings at six Weather Bureau stations next month.

At Nashville, Tenn.; Sault Sainte Marie, Mich.; Omaha, Nebr.; Oklahoma City, Okla.; Fargo, N. Dak., and Oakland, Calif., the instrument will be carried aloft each morning by a small balloon inflated with helium. The response of weather-sensitive elements in the observatory end of the instrument to changes in the surrounding atmosphere causes the miniature wireless station to send out sound signals. From their audio frequency, these signals, received at a ground station, can be translated into terms of temperature, pressure and humidity of the air at all heights reached by the robot weather observer.

"Regular use of the radiometeorograph," according to Dr. W. R. Gregg, "marks the beginning of a new epoch in meteorological service." Until upper air data became available, forecasts depended mainly on ground observations of the distribution and movement of air masses. This system finally reached its limit in accuracy. With more upper-air data, obtained by self-recording instruments borne by balloons and airplanes, greater accuracy in forecasting now becomes possible.

The radiometeorograph has several advantages over the airplane as a weather explorer. It can go higher —10 to 20 miles above the earth, which is well up into the stratosphere. It can take off in weather that grounds planes, thus supplying observations at critical times in weather history. It reports its findings instantly, doing away with the hour or longer wait for the return of the recorder. The radiometeorograph, however, does not provide information on the direction or velocity of the wind. New observation technique now being developed in the laboratory will add this information.

Tests at two Weather Bureau stations last year proved the value of the radiometeorograph in making daily upper-air soundings. The essential parts of various models used last year and of the one to be used this year are the same—a unit that responds to atmospheric changes and a radio transmitter that reports the atmospheric changes as sound signals, which are picked up at ground stations of the Weather Bureau. The official announcement reads in part as follows:

> The weather-sensitive elements of the new radiometeorograph are several strands of human hair, which tighten or loosen as the air around them becomes drier or more moist, and a small glass tube filled with sulphuric acid which responds to changes in temperature. Last year's radiometeorographs were kept running by a special clockwork. This year's model depends on changes in atmospheric pressure to make it run. The decrease in atmospheric pressure as the instrument rises moves a small switch arm over a series of equally spaced electrical contacts, separated by insulating strips. The contacts are spaced so that a decrease in air pressure equivalent to several hundred feet of elevation makes the switch arm move from a contact to an insulating strip. The next decrease makes it move to the next contact, and so on until the carrier balloon bursts and the radiometeorograph, attached to a small silken parachute to break the fall, drops back to earth. In nine times out of ten, at stations in well-populated regions, it is recovered and returned to the Weather Bureau.

THE NEW LABORATORY OF CHEMICAL ENGINEERING AT THE CASE SCHOOL OF APPLIED SCIENCE

THE Board of Trustees of Case School of Applied Science has authorized the immediate construction of the first unit of a new laboratory of chemical engineering, which when completed will cost approximately $750,000. The first unit will comprise about 0 per cent. of the ultimate structure and will cost upwards of $300,000. Construction will be started this summer and the schedule calls for completion in advance of the second semester of the college year.

The building is to be of brick and steel construction. The main portion is to be 64 by 100 feet and four stories in height, with a two-story extension 45 by 55 feet to house large pieces of equipment and to provide special protection against risks of fire or explosion. The first unit will be at the southeast side of the campus adjoining the present electrical building in space now used as a parking area. Later extensions are to occupy the site of the latter building, which it is hoped to replace by a modern laboratory on the southwest front of the campus. Until the final unit of this building can be erected, the present chemical laboratory will be kept in service. Dr. Carl F. Prutton, head of the department of chemical engineering, made an extensive survey of college and industrial laboratories before deciding on plans for the new building. He will have charge of the selection and arrangement of its special equipment.

The unit to be constructed at the present time will provide principally for the distinctly engineering features of the department. The basement will include a large industrial process laboratory 80 by 40 feet, additional grinding, drying and research laboratories, an instrument room, and maintenance and repair shop. The extension will have 35 feet of headroom with a balcony at the 17-foot level covering about half the area. Special booths of reinforced concrete will be provided for experiments involving inflammable, explosive or high pressure reactions.

The first floor of the main structure will have a large senior laboratory of 45 by 85 feet where plant development problems and thesis projects will be handled. This laboratory will provide for sixty-four men at the beginning and provision is made to expand its capacity to eighty. A complete shop will be provided where students may construct their own apparatus. A furnace room for heat reaction experiments, a precision weighing room, research rooms and offices will also be on this floor. The two upper floors will provide an organic laboratory 60 by 45 feet with an ultimate capacity of ninety-six students, a fuel laboratory 60 by 20 feet, a laboratory of physical chemistry, recitation rooms, offices and research laboratories. Distilled water apparatus and ventilating equipment will be placed in a penthouse on the roof. Contaminated air from the laboratories will be completely renewed every four minutes. Unit steam heaters will be employed during the winter months.

THE FIFTH INTERNATIONAL CONGRESS FOR APPLIED MECHANICS

THE fifth International Congress for Applied Mechanics, which is held every four years, will meet at the Massachusetts Institute of Technology from September 12 to 16, under the presidency of Dr. Karl T. Compton, president of the institute. An attendance of three hundred members is expected. The last session of the congress was held in 1934 at the University of Cambridge.

Much of the work of the congress will be conducted at various technical sessions, at which international leaders in the field will present reports on their latest research and participate in informal discussions with other delegates. There will also be several general lectures designed to give a comprehensive rather than specialized view of the major problems of applied mechanics. The official languages of the congress are English, French and German.

To facilitate the presentation of technical papers the field of applied mechanics has been divided into three sections. One will deal with structures, elasticity, plasticity, fatigue, strength theory and crystal structure. A second section will concern hydro and aero dynamics, gas dynamics, hydraulics, meteorology, waterwaves and heat transfer. The third division will focus attention on the dynamics of solids, vibration and sound, friction and lubrication and wear and seizure.

The new Wright Brothers Memorial Wind Tunnel for aeronautical research at the Massachusetts Institute of Technology will be dedicated and numerous other exhibits of engineering equipment and demonstrations of research apparatus are being arranged. At the close of the congress delegates from foreign countries will be given the opportunity to visit the research centers of the East. These will include a trip to Washington to visit government laboratories, one to the Langley Memorial Laboratory of the National Advisory Committee for Aeronautics at Langley Field, Virginia, and others to the large industrial plants and research laboratories of Pittsburgh, Detroit, Niagara Falls and Schenectady.

Among those expected to participate are:

Professor K. Federhofer, of the Graz Technical School, Austria; Professor L. Baes, of the University of Brussels; Professor K. Popoff, of Sofia, Bulgaria; Professor K. Koerner, of the Prague Technical School, Czechoslovakia; Professor V. Bjerknes, of the University of Oslo; Professor E. Nicolai, of the Polytechnical Institute, Leningrad, and Professor H. U. Sverdrup, of the University of Bergen.

From England: Professor L. Bairstow, of the Imperial College, London; Professor R. V. Southwell, of the University of Oxford, and Professor G. I. Taylor, of the University of Cambridge.

From France: Professor E. Hahn, of the University of Nancy, and Professor E. Jouguet, Professor J. Pérès and Professor P. Villat, of the University of Paris.

From Germany: Professor R. Grammel, of the Stuttgart Technical School; Professor L. Prandtl, of the Kaiser Wilhelm Institute, Göttingen; Professor F. Koerber, of the Kaiser Wilhelm Institute, Dusseldorf, and Professor E. Trefftz, of the Dresden Technical School.

From Italy: Professor C. Guido, of Torino, and Professor Tullio Levi-Civita, of the University of Rome.

From Holland: Professor C. B. Biezeno and Professor J. M. Burgers, both of the Delft Technical School, and Professor E. B. Wolff, of the University of Amsterdam.

Professor Jerome C. Hunsaker, head of the department of mechanical engineering of the Massachusetts Institute of Technology, is secretary of the congress. Dean H. M. Westergaard, of the Harvard Graduate School of Engineering, is chairman of the committee in charge of the arrangements for the meeting.

THE INFANTILE PARALYSIS FOUNDATION

The following account is given of the Infantile Paralysis Foundation in the *Journal* of the American Medical Association:

Basil O'Connor, New York, president of the National Foundation for Infantile Paralysis, in a lette addressed to President Roosevelt on June 21 announced the appointment of a general advisory committee and four subcommittees to advise the foundation on the allotment of its funds. At that time Keith Morgan, New York, chairman of the Committee for Celebration of the President's Birthday, presented to the President a check for $1,010,000 as the principal instalment of the funds raised in the 1938 celebrations. It is expected that about $50,000 more will be added when the auditor's report is completed. The general committee has the following members:

Dr. Irvin Abell, Louisville, Ky., president of the American Medical Association.

Dr. Philip Lewin, associate professor of orthopedic surgery, Northwestern University Medical School, Chicago.

Dr. Thomas Parran, surgeon-general, U. S. Public Health Service, Washington, D. C.

Dr. Max Minor Peet, professor of surgery of the University of Michigan Medical School.

Dr. Thomas M. Rivers, director of the Hospital of the Rockefeller Institute for Medical Research, New York.

Dr. Rivers is chairman of the subcommittee on scientific research, of which the members are: Dr. Donald B. Armstrong, Metropolitan Life Insurance Company, New York; Dr. George W. McCoy, U. S. Publi Health Service, Washington, D. C., and Dr. Karl F. Meyer, Hooper Foundation, University of California, San Francisco. Dr. Parran heads a committee on public health which will give aid in time of epidemics; members are: Drs. Don W. Gudakunst, state healt officer of Michigan, Lansing, and George H. Ramsey, health commissioner of Westchester County, Whit Plains, N. Y. Dr. Peet is chairman of a committee o education, with Dr. Abell and Dr. Morris Fishbein, editor of the *Journal* of the American Medical Association, Chicago, as the other members. Dr. Lewin is chairman of a committee on treatment of aftereffects; other members are: Drs. George E. Bennett, associate professor of orthopedic surgery, the Johns Hopkins University School of Medicine, Baltimore; Charles Le Roy Lowman, Los Angeles Orthopedic Hospital, Los Angeles; Leo Mayer, associate professor of clinical orthopedic surgery, Columbia University New York Post-Graduate Medical School, New York, and Frank R. Ober, assistant dean and clinical professor of orthopedic surgery, Harvard University Medical School, Boston. The foundation has adopted the policy of assisting in study and research on the medical problem as a whole and not of giving individual care for those afflicted. It is felt that the problem of locating crippled children and providing medical, surgical, corrective and other services and care and facilities for diagnosis, hospitalization and after-care of the individual case is essentially a local problem and that the foundation must confine itself to aiding institutions and centers in which methods or procedures may be developed which will be of benefit to all the afflicted.

SCIENTIFIC NOTES AND NEWS

AT the opening ceremony of the fifteenth International Geographical Congress at Amsterdam on July [illegible], honorary memberships in the Royal Dutch Geographical Society were conferred on Dr. Elmer Drew Merrill, professor of botany and administrator of the botanical collections of Harvard University, in recognition of his work in botanical geography, and on Professor Carl Ortwin Sauer, professor of geography and chairman of the department, at the University of California, in recognition of his work in physical and social geography.

A TESTIMONIAL dinner was recently given by alumni of the University of Michigan to Dr. James W. Glover, James Olney professor of mathematics and chairman of the department, who retired from active teaching at the end of the academic year. In his honor the James W. Glover scholarship fund, made possible by contributions from his former students, was announced, and a check for $800, as the nucleus of this fund, was presented to the university and was received by Vice-President Shirley W. Smith. There was also presented a volume containing many voluntary letters received by the committee, expressing admiration and affection for Dr. Glover.

DR. A. W. HOMBERGER, professor of chemistry and head of the department at the University of Louisville, was given at the close of the academic year a testimonial dinner sponsored by the Chemistry Club Alumni Association, in recognition of his twenty years' service to the university. The dinner was participated in by about one hundred and fifty of his colleagues, former students and friends. Dr. A. J. Miller, head of the department of pathology of the School of Medicine, acted as master of ceremonies. A silver tray with the insignia "H_2O" engraved on it was presented to Dr. Homberger in token of appreciation of the Alumni Chemistry Club.

Nature writes: "Among the distinguished scientific men of science who have left Vienna since the *Anschluss* is Professor Sigmund Freud, who has taken refuge in London. Professor Freud celebrated his eighty-second birthday on May 6 last. His name will always be associated with the development of psychoanalysis, and the significance of his contributions to psychology was acknowledged by his election in 1936 to foreign membership of the Royal Society, but Professor Freud had not hitherto been able to sign the roll of membersnip. Although now resident in London, Professor Freud was prevented by infirmity from attending the society's rooms for this purpose, and although the charter book is rarely removed from Burlington House except when it is taken to Buckingham Palace for the signature of the King as patron of the Society, it was decided to extend the privilege to Professor Freud. Accordingly, on June 23, Sir Albert Seward, foreign secretary, and Professor A. V. Hill, one of the secretaries, accompanied J. D. Griffith Davies, who as assistant secretary has custody of the charter book, to Professor Freud's residence, where the roll was duly signed by Professor Freud in the presence of his daughter, Dr. Anna Freud, and Princess Marie of Greece, who was a pupil of his and received him when he left Austria. On behalf of the Royal Society, Sir Albert Seward presented to Professor Freud an inscribed copy of a facsimilie of the society's charter book."

Two Rivers Memorial Medals for 1938 of the Royal Anthropological Institute, London, were presented at the recent annual meeting of the society to Professor A. R. Radcliffe Brown, for anthropological research in the Andaman Islands and Australia, and to Miss Dorothy Annie Elizabeth Garrod, for work in Gibraltar, Southern Kurdistan and Palestine. The Wellcome Gold Medal for 1937 for anthropological research was awarded to Dr. Meyer Fortes for a study of the "Marriage Law among the Tallensi."

AT the annual commemoration ceremony on May 14, the third Farrer Memorial Medal was presented to Dr.

W. L. Waterhouse, acting dean of the faculty of agriculture of the University of Sydney.

The degree of doctor of science has been conferred by Washington University on Oakes Ames, research professor of botany and director of the Botanical Museum, Harvard University. The citation made by Dr. George T. Moore, director of the Henry Shaw School of Botany, follows: "He calls the orchids by name in order that others may likewise know them. Final authority, whose published works, illumined by the accurate, artistic skill of Blanche Ames, his wife, are at once the admiration and envy of the botanical world."

The doctorate of engineering was conferred by the University of Michigan at commencement on Dr. Stephen Timoshenko, formerly professor of mechanical engineering, who was recently called to Stanford University.

Wesley P. Sykes, research metallurgist at the Cleveland Wire Works of the General Electric Company, was awarded the honorary degree of doctor of engineering at the fifty-fourth annual commencement exercises of the Case School of Applied Science.

Colonel Charles Franklin Craig, Medical Corps, U. S. Army, retired, will retire as professor of tropical medicine and head of the department at the Medical School of Tulane University of Louisiana on September 1. He has been appointed emeritus professor of tropical medicine.

Dr. Ralph E. Cleland, professor of biology at Goucher College, has been appointed head of the department of botany at Indiana University.

Dr. William M. Hale, assistant professor at the Yale University School of Medicine, has been appointed professor and head of the department of bacteriology of the College of Medicine of the State University of Iowa.

Dr. William Lindsay Malcolm, professor of municipal engineering in Queens University, Canada, has been appointed director of the School of Civil Engineering in the College of Engineering of Cornell University.

At Lehigh University, Professor Hale Sutherland, head of the department of civil engineering, has been appointed director of the Fritz Laboratory. Dr. Bruce Gilbert Johnston, of Columbia University, has been appointed assistant professor of civil engineering and assistant director of the laboratory. He succeeds Dr. Inge Lyse, who resigned recently to accept a professorship in the Institute of Technology of Norway.

At Northwestern University, John Fyfer Calvert has been appointed professor of electrical engineering; L. T. Wyly, assistant professor of civil engineering, and Paul D. Parker, assistant professor of mechanical engineering. The appointments are part of the enlarged teaching and research program for the School of Engineering which has been developed in cooperation with the Engineers' Council for Professional Development.

Dr. Willard Z. Park, of the department of anthropology of Northwestern University, has been made head of the combined departments of sociology and anthropology at the University of Oklahoma; Dr. Donald B. McMullen, formerly head of the department of biology at Monmouth College, has been appointed assistant professor of bacteriology, in charge of the division of parasitology at the Medical School.

The J. T. Baker Chemical Company research fellowship in analytical chemistry, Eastern Division, h been awarded for the academic year 1938–1939 to C. Barton, who will work at the University of Virgin under the direction of Professor J. H. Yoe in the fi of photoelectric colorimetry. Members of the co mittee making the award are: Professors G. P. Baxte (Harvard), H. A. Fales (Columbia), C. W. Maso (Cornell), J. H. Yoe (Virginia), and N. H. Furma (Princeton), *chairman.*

Dr. Alexander R. Todd, of the Lister Institute o Preventive Medicine, London, has been appointed t succeed Dr. I. M. Heilbron as Sir Samuel Hall pr fessor of chemistry and director of the Chemical La oratories of the University of Manchester.

Dr. Stanley Patrick Davidson, Regius profess of medicine in the University of Aberdeen, has bee appointed to the chair of medicine at the Universit of Edinburgh in succession to Professor W. T. Ritchi

Grants have been made by the Committee on Scie tific Research of the American Medical Association follows: To the medical department of the School Medicine and Dentistry of the University of Rochester for work dealing with agranulocytosis in the ca to be carried out under the direction of Dr. John S Lawrence; to Dr. Roe E. Remington, professor o chemistry and director of the Food Research Laboratory of the South Carolina Food Research Commi sion, for work on iodine metabolism in the rat; Dr. Joseph H. Roe, professor of biochemistry in t School of Medicine of the George Washington Unive sity, for work upon the specificity of methods for t determination of ascorbic acid in plant, animal a tumor tissues; to Dr. Louis N. Katz, director of c diovascular research, the Michael Reese Hospital, C cago, for studying factors influencing the activities the heart to be carried out in the isolated heart pre station; to Dr. Maurice Barnes Woodhall, Duke Hospital, Durham, N. C., for a further study of the reaction of central nervous system tissue to transplanted rabbit papilloma, and to Dr. Charles W. Turner, professor of dairy husbandry at the University of Missouri, for work on the relation of thyrotropic hormone of the anterior pituitary to pregnancy and ctation.

DR. HUGH S. CUMMING, formerly surgeon general the U. S. Public Health Service, has returned to the ited States. He attended a meeting of the Commit- of the National Health Office in Paris on April 9 d a meeting in Geneva on June 30 of the League of tions Health Office.

DR. HENRY TEUSCHER, superintendent and chief hor- ulturist of the Botanical Garden of Montreal, has t to visit the botanical gardens and the main hor- ltural centers of Europe. He will study the con- ction of large greenhouses in view of the plans for greenhouses to be constructed next winter at the treal Botanical Garden. The work at the garden rogressing actively. About two hundred and fifty s are now in course of development.

THE Society of American Bacteriologists will hold fortieth general meeting on August 30, 31 and tember 1, in San Francisco, Calif., at the Hotel rmont, under the presidency of Dr. Paul F. Clark, the University of Wisconsin. The program in- des groups of papers in the fields of general, med- , agricultural and industrial bacteriology. Sym- ia have been arranged on the subjects of nitrogen- ion, metabolism, filterable viruses and immunity. int meeting of all the sections of the society will der the subject of enzymes in relation to bacteri- y. Round-table discussions on the following topics be held: staphylococci, spirochetes and spiro- al diseases, non-symbiotic nitrogen-fixation and the s-inoculation of leguminous plants.

E Massachusetts Institute of Technology an- nces a conference to be held on September 8 and 9, er the direction of the department of mathematics the department of economics and social science, the application of statistical methods to industrial and engineering problems. Addresses and discussions will include a résumé of certain statistical technique needed for effective handling of industrial data, successful applications of statistical methods in the fields of engineering and quality control, contemporary developments in industrial and engineering statistics. Among those who will address the conference are L. H. C. Tippett, of the British Cotton Industry Research Association; Dr. Walter A. Shewhart, of the Bell Telephone Laboratories; and Dr. S. S. Wilks, professor of statistics at Princeton University. The evening of September 9 will be devoted to applications of statistical methods in the fields of biology and medicine. All correspondence should be addressed to the Secretary, Conference on Engineering and Industrial Statistics, Massachusetts Institute of Technology, Cambridge, Massachusetts.

THE International Congress on Rheumatism will meet in New York in June, 1940. Dr. Ralph Pemberton, of Philadelphia, is president. Subjects to be discussed will be the role of infection in rheumatic diseases, nutrition in rheumatism and the social significance of orthopedic work in rheumatic diseases. A symposium on therapy in rheumatism will be arranged.

THE Sheffield Scientific School of Yale University has received bequests amounting to more than a million dollars. They are a residue interest in the estate of Frederick W. Vanderbilt, '76, of New York City, and $664,749 from the estate of Miss Marie Oakes Hotchkiss, of East River, Conn.

LORD NUFFIELD has offered to give £60,000 to the University of Birmingham for the extension of the department of physics. Of this a sum of £40,000 is to be used for the building, the remainder being reserved for equipment and maintenance and for the foundation of a research scholarship. The plans for the new block provide for a professor's room and secretary's office, a staff room and library. The central part is a research hall for high-voltage work, this being flanked by eight research rooms, each about 16 feet by 14 feet. There are to be also a machine-room and workshop, two dark rooms and a basement room for high-energy x-ray work.

DISCUSSION

CHEMICAL CONTROL OF STARFISH[1]

E common starfish, *Asterias forbesi*, is the most uctive enemy of the oyster along the North At- Coast. Efforts have been made to eradicate it t least a century, but these attempts have been ely unavailing. The method in present use by oystermen consists in gathering the starfish from the bottom by the use of dredges and special starfish mops and destroying the captured animals by immersion in hot water. This method is slow, however, and the unabated depredations of starfish on the oyster beds attest its inefficiency.

Experiments looking toward the development of a method of chemical control have been carried on by

[1] ublished with permission of the U. S. Bureau of ries.

the U. S. Bureau of Fisheries for several years. In early experiments substances such as copper sulfate were used. Although this substance proved lethal to starfish, several disadvantages attended its use. Because of its great solubility large quantities were needed to create a concentration lethal to starfish, a procedure too expensive to be of practical value. A further disadvantage was the fact that many marine organisms besides starfish were killed by the chemical.

Since 1937 experiments on the destruction of starfish by the use of calcium oxide or quicklime have been carried out by the senior author at the Milford Laboratory. The possibility of using calcium oxide for combatting starfish was first suggested by Wood.[2] Recently this substance has been used by the oystermen on grounds located in Long Island Sound.

Under laboratory conditions calcium oxide in powder form proved to be more effective than coarser grades because it covered the bottom more evenly. All starfish in the outside experimental tanks died within 5 to 10 days after being treated with powdered calcium oxide. The chemical was applied at the rate of 300 pounds of powdered substance per acre of bottom.

In the spring of 1938 the experiments were transferred to the oyster beds of Long Island Sound where starfish are abundant. Both powdered and coarse grades of lime were used, the latter having been found to retain its effectiveness longer than the fine. The efficiency of the method on the natural oyster bottoms depends wholly upon the uniform distribution of calcium oxide particles over the treated area and upon the quantity of the chemical used. On 25 acres of starfish-infested oyster bottom treated with calcium oxide at the rate of 480 pounds per acre as many as 80 per cent. of the starfish were found to be affected by the chemical one week after the beginning of the experiment.

The destructive effect of calcium oxide upon starfish is produced by direct contact. Particles of the chemical quickly sink to the bottom, and, falling on the aboral surface of the starfish, imbed themselves in the ciliated epithelium covering the animal. Caustic action of the slaking chemical rapidly disintegrates the delicate skin membrane. The lesions rapidly increase in size, spreading in all directions and involving the branchiae and other surface structures. After several days the lesions penetrate the body wall and the internal organs become exposed. Death usually follows in a short time.

Once spread on the bottom, the chemical retains its effectiveness for some time. Starfish which are not directly hit by the falling particles when the chemical is applied eventually come in contact with it by crawling on the bottom. In the course of time the lower or oral surfaces of the starfish become affected and disintegration begins.

It has been observed that starfish with large lesions are usually attacked by other starfish and crabs which quickly kill and eat them.

The advantages of calcium oxide as a practica weapon against starfish are many. Of special in portance is the fact that it does not appear to very injurious to many other forms of marine lif No mortality has been observed among other botto forms such as oysters, clams, several varieties of crab barnacles or adult flounders. Many of these anim were kept for as long as three months without a parent effect in large experimental tanks to which t chemical had been added. Studies on the effect calcium oxide on plankton are now in progress.

Being at once effective and easy to apply, the n method is considered especially suitable for practi use. It should be of particular value in exterminati starfish on public or abandoned oyster bottoms, whic as shown by Loosanoff,[3] are the centers of propagatio and dispersal of starfish in Long Island Sound.

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PREPARATION OF l-GLYCERIC ALDEHY

WE have prepared l-glyceric aldehyde in the follo ing way:[1] l-arabinose → l-mannonolactone → l-ma nitol → 1,2–5,6-diacetone-l-mannitol → acetone glyceric aldehyde → l-glyceric aldehyde (2,4-dinit phenylhydrazone m.p. 148°, dimedone compound m 198–200°, $[\alpha]_D^{21°} = -198°$ in alcohol).

The optical rotations of the l- and d-glyceric al hyde decrease after some time in aqueous solution fr −14° to −7° and from +14° to +7°, respectively. H ever, the aldehyde content of the solution rema unchanged. By evaporating the aqueous solution dryness, the higher-rotating forms of both aldehy can be regained. Thus we have a kind of "mutaro tion," *but no racemization.* This point seems to important because of its biological consequences.

A complete report will be published elsewhere.

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[2] B. F. Wood, *Rept. State of Conn. Shellfish Comm.*, 94–98, 1908.

[3] V. L. Loosanoff, *Rept. State of Conn. Shellfish Co* 10–14, 1936.

[1] Preparation of d-glyceraldehyde, *cf.* H. O. L. Fis and E. Baer, *Helv.*, 19, 524, 1936.

DIRECTION OF SOLUTION FLOW AND THE FORMATION OF MINERALS

IN a moving solution the field of environment and any resulting chemical activity are asymmetric with respect to a plane normal to solution movement. Crys- l products formed in the laboratory in a moving eam of solution display a number of features uliar to each end of the polar axis of flow. Mineral l ore specimens show similar asymmetric features ich may be recognized in one mineral species and by the relations between two or more species. idea is also extended to larger scale geological bodies where the same principle of asymmetric development of mineral bodies (ore deposits) should obtain.

The problems differ in open space fillings and replacements, but the principles of asymmetric development, linearity, linear distortion and stoss and lee effect are common to both. Investigation is continuing in the interrelation of these features and the structural relations of both open space fillings and replacement deposits.

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SCIENTIFIC BOOKS

SCIENCE IN THE SOUTH

ntific Interests in the Old South. By THOMAS ARY JOHNSON, JR. viii + 217 p. New York and ndon: D. Appleton-Century Co., Inc., For the titute for Research in the Social Sciences, Uni- sity of Virginia. 1936. Price $2.50.

IS is a source book of details derived from extensive and exhaustive review of available rces, books, periodicals, newspapers, catalogues and emeral publications of universities, colleges, acad- es, seminaries, museums and other educational rprises south of the Mason and Dixon line prior to Civil War. The author's theme is the refutation the summary indictment by Morrison in "The ord History of the United States," volume 2, page f the "non-existent intellectual life" of the South, o the cultivation of cotton, the neglect of men and light of human slavery. The data assembled tend pport his defence, for they display a wide-spread active interest in the physical, chemical and medi- elds, and a considerable though desultory activity e natural sciences. An outstanding center of tific activity was Transylvania College, with its essive catalogue of scientific apparatus and book listing a very complete collection of early nine- th century memoirs. "It passed its zenith in ." Charleston was another brilliant center of tific interest. Here the Elliott Society of Natural ory started off in its *Proceedings* (1859) with a display of productivity only to be snuffed out by ar. New Orleans, with its considerable infusion ench blood at a period of intellectual activity in , also became noted for its interest in scientific ers.

arrangement of the material does not facilitate tation from a scientific approach except by way e index. The subject-matter is grouped under headings as "in college halls, among the people, Southern girls, the glory that was Charleston, the glamour of New Orleans, and scattered scientists." This aroma of a social and historical approach to the subject pervades all the chapters. Details of evidence of educational interest abound, but a synthesis of accomplishment in the several disciplines of the sciences is not achieved. There is a noticeable absence of evidence of sustained scientific activity by productive investigators in scientific fields. The publications cited at considerable length from De Bow's *Review* (New Orleans, 1846–1880) are mainly of a general or popular nature, or are reviews of publications elsewhere. The *Southern Review* (Charleston, 1828–1832), the *Southern Quarterly Review* (New Orleans, Charleston and Columbia, S. C., 1842–1856), and the *Literary Messenger* (Richmond, 1834–1864) all contained some scientific articles of this general character indicating a wide-spread interest in science, but there is nothing in the South comparable to the American Philosophical Society of Philadelphia, the Linnaean Society of New York or the American Academy of Arts and Sciences of Boston. The early interest of the South in these organizations fell off in later years, and no local academies of significance were originated locally in the South.

The author cites with just pride the scientific eminence of Dr. William Charles Wells, of Charleston, South Carolina. This pioneer is cited for his anticipation of the theory of natural selection. Wells undoubtedly owed much to Dr. Alexander Garden, his Charleston mentor and correspondent of the Royal Society of London. He also utilized his medical knowledge of tuberculosis and malaria gained in native Carolina as data for his concept of natural selection operating differentially upon white and Negro races of man. But Wells was educated in Edinburgh, and was driven out of the States because of his vigorous loyalist sympathies. Later he was a member of the medical faculty in London and a member of a coterie of leading intellectuals, including the Hunters, Baillie and others. He was a member of the Royal Society of London, and all his scientific work was done and published there. The author cites the sixth edition (1873) of the "Origin of Species" as the place of acknowledgment by Darwin of the priority of Wells's publication of the concept of natural selection, whereas Darwin first published this in the fourth edition (1866, p. xiv). Wells was not only a pioneer in evolution and physics (of dew) but also in ophthalmology (theory of vision) and epiden ology.

Scientists are peculiarly subject to environment influences. Their best work has been done under tl aegis of intellectual freedom. Wells spent his energi in Carolina in political turmoil. Fortunately, scienc knows no race, nationality nor region.

Charles A. Kofoid

SPECIAL ARTICLES

YELLOW FEVER VIRUS IN JUNGLE MOSQUITOES[1]

Until recent years yellow fever was regarded as a house disease, transmitted solely by the domestic mosquito, *Aedes* (*Stegomyia*) *aegypti* (Linnaeus). The existence of a special epidemiological type of the disease, now known as jungle yellow fever, became evident when it broke out under rural and jungle conditions in the Valle do Chanaan, Espirito Santo, Brazil, in 1932. During the course of the epidemic no trace of the classical vector could be found in the infected area.[2]

Since then over 20 similar outbreaks have been observed in various parts of South America (Colombia, Peru, Bolivia, Paraguay and most of the Brazilian states.)[3] Study has shown that during such outbreaks man is generally infected only while in contact with the forest or jungle. Household infections are not common, except where the house stands within the jungle.

It has been shown experimentally that a number of Brazilian mosquitoes other than *Aedes aegypti* can become infected under laboratory conditions. Successful transmission by bite, however, has been obtained only with three species: *Aedes scapularis* (Rondani), *Aedes fluviatilis* (Lutz) and *Haemagogus capricorni* (Lutz).[4,5,6,7,8]

The 1938 outbreak of jungle yellow fever in the state of Rio de Janeiro, Brazil, afforded an opportunity to demonstrate the presence of yellow fever virus in mo quitoes caught in the jungle. Mosquitoes collect alive at points near where human infection had o curred were forwarded daily to the laboratory in R de Janeiro. They were first classified by species groups of species and then allowed to bite non-immu rhesus monkeys.[9] After feeding on the monkeys t insects were tested for the presence of yellow fe virus by a method previously described[11] but brie summarized as follows: They were killed, groun finely, suspended in a diluent and centrifuged, and t supernatant fluid was injected into mice intracer brally. This report is based on results obtained wi 24,304 mosquitoes sent in from the state of Rio Janeiro over a period of eleven weeks, the followi species being represented:

List of Wild-caught Mosquitoes Tested for the Presence of Yellow Fever Virus

Group	Species	Used	Fed	Remark
1	*Aedes scapularis* (Rondani)	180	100	
2	*A. leucocelaenus* (Dyar and Shannon)	4,671	2,270	Positive bite
3	*Haemagogus capricorni* (Lutz)	1,216	646	Positive bite
4	*Psorophora ferox*	253	143	
	P. albipes	15	7	
	A. fulvus (Wiedemann)	8	5	
	A. serratus (Theobald)	1,570	545	
	A. terrens (Walker)	503	58	
5	*Sacbethes*, 3 species	1,092	369	
6	All other sabethines (*Sabethoides*, *Limatus*, *Wyeomyia*, *Goeldia* and *Trichoprosopon* (*Joblotia*), totalling about 20 species	14,796	3,443	Positi injecti

Positive results were obtained from the follo

(1) *Aedes leucocelaenus* (D. and S.). On Febr 22, Monkey 5, on which a total of 16 *A. leucocela*

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[1] From the Cooperative Yellow Fever Service of the Ministry of Education and Health of Brazil and the International Health Division of The Rockefeller Foundation, Rio de Janeiro.

[2] F. L. Soper, H. A. Penna, E. Cardoso, J. Serafim, Jr., M. Frobisher, Jr., and J. Pinheiro, *Am. Jour. Hyg.*, 18: 555–587, 1933.

[3] F. L. Soper, *Quart. Bull. Health Org., League of Nations*, 5: 1–50, 1936.

[4] We are indebted to Dr. P. C. A. Antunes for the recent information that *Haemagogus janthinomys* (Dyar) 1921 is a homonym of *H. capricorni* (Lutz) 1904.

[5] N. C. Davis and R. C. Shannon, *Jour. Expt. Med.*, 1: 803–808, 1929.

[6] N. C. Davis and R. C. Shannon, *Am. Jour. Trop. Med.*, 11: 21–29, 1931.

[7] L. Whitman and P. C. A. Antunes, *Am. Jour. Trop. Med.*, 17: 803–823, 1937.

[8] L. Whitman and P. C. A. Antunes, *Am. Jour. Trop. Med.*, 17: 825–831, 1937.

[9] The methods used for collecting, shipping, classify and feeding will be dealt with in a subsequent pap

[10] R. C. Shannon, "Methods for Collecting and Fee Mosquitoes in Jungle Yellow Fever Studies." *In pr ration.*

[11] L. Whitman, *Jour. Exp. Med.*, 66: 133–148, 1937.

om Affonso Arinhos had fed on February 7, 9, 10, 11 d 14, was found prostrate in its cage with a subnor- al temperature and was sacrificed. This animal owed fever on the 17th, 18th, 19th and 21st, but was ot bled because of its previous irregular temperature. icroscopic examination of the liver showed typical esions of yellow fever, including inclusion bodies, and e blood drawn on the day of death gave positive ouse-protection test results. While it was impossible fix the date of infection of Monkey 5, experience ith other animals suggested that infection probably ccurred on the 14th, when only one specimen of . *leucocelaenus* fed.

(2) *Haemagogus capricorni* (Lutz). Between Feb- uary 7 and 11, six *H. capricorni*, also collected at ffonso Arinhos, were allowed to feed upon Monkey Between February 24 and 26, twelve additional sects of the same species, collected near Bemposta d Pedro do Rio, were allowed to bite the same ani- al. The monkey first showed fever on February 28 nd died three days later. Autopsy findings followed by microscopic examination of the liver indicated that e animal died of yellow fever. Blood drawn on the st day of fever caused typical yellow fever encephali- in mice. Blood drawn shortly before death pro- ced fatal encephalitis in one of six mice, and also ve positive mouse-protection test results.

It is believed that Monkey 4 became infected from ot of four mosquitoes which fed on it on February 24. n emulsion of these mosquitoes injected into mice used typical yellow fever encephalitis. Monkey 3 s inoculated with second-passage mouse-brain mate- l, with the result that virus was demonstrated in the od stream and specific yellow fever antibodies were terward found to be present in the serum.

The supernatant fluid from an emulsion of 118 *H. pricorni*, collected in the same infected areas of Bem- sta and Pedro do Rio on March 10, produced en- phalitis in mice. Transfer of infective brain material ulted in infection of Monkey 6, with demonstrable ulating virus, and the production of specific im- nity as shown by the mouse-protection test. Fifty- ht of the mosquitoes included in this emulsion had on Monkey 8 without infecting it.

3) *Sabethine Mosquitoes.* Owing to the numerous ies in the sabethine group and the difficulty of ed-eye classification, it proved impractical during preliminary study to separate the sabethines by cies previous to feeding and injection.

wenty-one of 88 specimens in a mixed group of *bethoides, Limatus, Wyeomyia, Goeldia* and *Tricho- sopon*, caught together with the first lot of infected *emagogus* at Bemposta and Pedro do Rio, February fed on Monkey 9. This monkey developed no evi- ce of infection or immunity. The inoculation of the supernatant fluid from an emulsion of the 88 mosquitoes, however, produced encephalitis in mice. Second mouse-passage material produced infection in Monkey 4A with circulating virus and the production of specific immunity.

These results show that one or more of the 88 specimens in this group had fed on an infected person or animal before capture. The negative results in Monkey 9 may have been due to failure of infected mosquitoes to feed, to the non-completion of the incubation period of the virus in the mosquito or possibly to inability of the infected species to transmit, even though capable of conserving the virus for long periods of time.

The evidence presented incriminates two species of forest-inhabiting mosquitoes, *Aedes leucocelaenus* (D. and S.) and *Haemagogus capricorni* (Lutz), as natural vectors of yellow fever, and indicates that one or more species of sabethine mosquitoes may harbor the virus of the disease without definitely implicating them in actual transmission.

R. C. SHANNON
LORING WHITMAN
MARIO FRANCA

THE TREATMENT OF SPONTANEOUS TUMORS IN DOGS BY THE INJECTION OF HEPTYL ALDEHYDE[1]

FOLLOWING the observation that the addition of heptyl aldehyde to the otherwise normal diet of mice harboring spontaneous carcinomas of the mammary gland brings about liquefaction and certain retrogressive changes of the tumors without injury to the animal by such treatment,[2] it seemed logical to test out the possibility that dogs suffering from spontaneous tumors might respond in a similar manner. The amount of material needed, however, to bring about retrogressive changes in tumors in mice by the addition of the material to the diet would be entirely too great for practical purposes in dogs. Consequently, the subcutaneous injection of small amounts of heptyl aldehyde has been injected into dogs (from 0.10 to 1.00 cc at a time). Injection of the material into mice was found to be impractical for the reason that ulceration at the site of injection invariably occurred. Even though liquefaction of tumors in mice was brought about by the injection of heptyl aldehyde at remote spots, this local reaction interfered with subsequent injections and even with complete recovery of the mouse from a single injection. Due, perhaps, to the tougher skin of the dog, local sloughing of tissue is not produced by the injection of freshly prepared heptyl aldehyde. Extreme care, however, of keeping the heptyl aldehyde free of excessive decomposition products has always been employed. A temporary edema was produced with the larger injected doses.

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[1] This experiment has been made possible by grants from the International Cancer Research Foundation, the Anna Fuller Fund and from the Jane Coffin Childs Fund. The dogs have been kept under normal outdoor conditions in the Whitney kennels at Orange, Connecticut.

[2] L. C. Strong, SCIENCE, 87: 144, 1938.

So far, ten dogs with various types of spontaneous tumors have received periodic injections of heptyl aldehyde. Improvement of the dogs by body weight increase, physical appearance and general activity has been the rule in all cases. Softening of the tumors (with complete regression of the mass in several dogs) has been obtained in all dogs, except one that has a mammary gland tumor which is heavily infiltrated with calcium. The same type of liquefaction has been obtained in dogs as was had in the tumors of the mammary gland in mice. Following periods of softening and of draining of clear fluid, the tumors as a rule have gradually disappeared.

Injections have usually been performed at sites remote from the tumors. In a few cases, however, when the tumor was large (the size of a baseball or larger), the first injection was performed directly into the tumor and this was followed, when the tumors began to slough off, by injections at remote sites to the tumors.

The details of this investigation shall be published within a reasonable time. The data so far obtained, however, are so encouraging that this note is published.

The first two dogs with spontaneous tumors (both fibroadenoma of the mammary gland, as indicated by biopsy) which have been given the present treatment of the injection of heptyl aldehyde warrants further comment. One dog, a cocker spaniel female, eight years old, had numerous hard nodules throughout the mammary gland. These ranged in size from a pea to a lump 2.5 inches in diameter by $\frac{5}{8}$ inch thick. A mass 2 inches in diameter had been removed by operation a year previously. The dog had not had a normal heat period for more than two years. For example, at her last period in August–September, 1937, she had remained in heat for at least 40 days, during which time she accepted a male eight times over the entire period without any signs of pregnancy. Two months following the start of the first treatment with heptyl aldehyde she had a normal heat period. She was bred to a male normally and twenty-four days later, she had normal size embryos. These embryos subsequently became resorbed—a phenomenon which is not surprising when it is realized that heptyl aldehyde in mice acts as an abortifacient. This resorption of embryos may, however, have been due to the age of the dog. The dog has gained weight and is in normal health at the present time without any sign of tumor. The second dog, a Scottish terrier of similar age, had a solitary nodule in the breast about the size of a small orange. After several treatments with heptyl aldehy (remote to the tumor) the mass completely regresse The dog has gained weight and is apparently in normal health, having since treatment had a normal hea period, whereas, previously she had a long history of prolonged and abnormal heat periods with numerou failures to conceive.

It is realized that spontaneous tumors in dogs d occasionally regress. It is also recognized that ma dogs do continue to grow their tumors until dea results. The proper analysis and evaluation of th present data must wait until statistically significa numbers are obtained. The data so far obtained a noteworthy, and it is planned to carry on the wor on a larger series of dogs and other animals sufferi from spontaneous tumors.

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RELATIONSHIP BETWEEN MEAN SEA LEVEL AND SAND MOVEMENTS[1]

AT the Scripps Institution of Oceanography ther is a 1,000-foot pier, extending from a sandy beach into the open ocean. For two years, weekly measu ments of sand elevations were made from the pi to determine the beach profile and the changes sand elevation. These observations were taken at st tions 20 feet apart, along the length of the pier. Sin October, measurements have been made daily, a during one 36-hour period, on October 20 and 2 these measurements were made every 40 minutes.

Continuous readings of sea level are available fro the Coast and Geodetic Survey tide gauge, locat on the end of the pier. Averaging these hourly s level heights for days, weeks and months gives t mean sea level for these periods. The distances fro the deck of the pier to the sand at 50 equally spac stations were averaged for the same periods. Bo mean sea level and mean sand level show considera variation. The accompanying figure shows that th is a decided relationship between the two.

It will be observed that a rise or fall in mean level is accompanied by a rise or fall in the mean le of the sand. The average ratio of these change roughly 3 to 1, that is, a rise of one foot in m sea level is accompanied by approximately a th foot rise in the mean level of the sand. The agreem of course is not perfect, and some instances of mar deviations will be observed.

These changes show a distinct relationship to seasons during the two-year period. It will be no

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[1] Contributions from the Scripps Institution of Oc ography, New Series, No. 7.

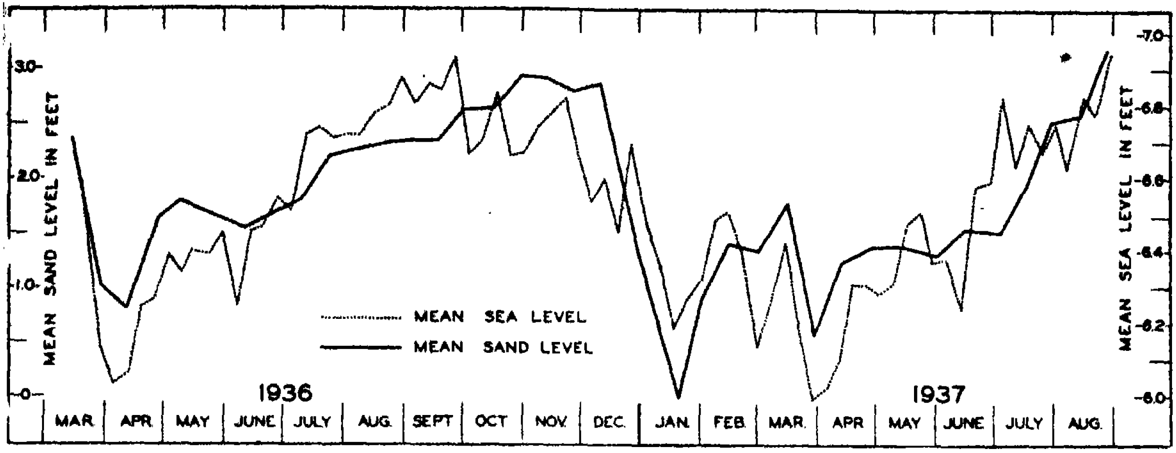

FIG. 1. Relationship between mean sea level and mean sand level. Sand level is expressed in feet above the west level and sea level is the tide staff reading in feet.

at there is a rise each summer and fall and a decline winter and spring. However, it is not only in these *rge seasonal changes that the agreement of the two* rves is found. Changes in shorter periods can be bserved, as, for example, the rise in February and farch, 1937. Furthermore, the changes in tide level uring the 36-hour survey, when observations were nade every 40 minutes, showed that the variations of ide level were closely associated with the fill and cut sand along the pier.

The causal relationship of these changes to each her is not easily understood. It should not be conaded that the rise in sea level alone causes a building of the sand, but many of the factors which influence the sea level must likewise affect the sand movements. It seems likely that changing currents and *winds which affect sea level must have similar influence* upon the sand movements. Such an influence may be increased by large swells which tend to occur during certain wind directions and which stir up the sand and keep it in suspension.

Continued observations, which include current studies, wave height observations and meteorological data, together with the sand measurements, which are now in progress, may be expected to throw more light upon the underlying cause of this relationship.

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SCRIPPS INSTITUTION OF OCEANOGRAPHY

SCIENTIFIC APPARATUS AND LABORATORY METHODS

A SUBSTITUTE FOR CARGILE MEMBRANE IN THE CONSTRUCTION OF BRODIE BELLOWS

VOLUME recorders of the bellows type have a wide riety of application in physiological experiments, t their construction as described by the originator, die, and subsequent experimenters, involves the of Cargile membrane for the actual bellows. Car- membrane is the peritoneum of an ox and has been d by surgeons and goldbeaters, but unfortunately s now both difficult to obtain and quite expensive. arch was therefore made to find a suitable substi-.

e found that the Japanese tissue paper which is l in model airplane construction when properly pared works most admirably. Since the heavier s of this tissue are too stiff and tend to crack n folded, it is important that only the thinnest and hest variety be used.

he tissue is prepared for use in the following man-: Care being taken to avoid wrinkles, a section of the paper is placed over the open end of a tin can or other container of suitable size and shape and glued *at the edges with banana oil.* With a tuft of cotton the entire surface is gently moistened with water. This serves to align the fibers and stretch the tissue. In order to render it impermeable to air and moisture it must then be treated at least three times with a mixture of one part banana oil and five parts acetone. This is done by simply brushing the mixture on gently with a soft brush. The membrane may then be removed and will be found to be smooth and flexible.

The construction of the bellows is self-evident from the illustration, but great care must be exercised in applying the membrane so that it folds smoothly and without bulging out when the bellows is in actual use. Most efficiency was obtained when the membrane was first cemented on so that it formed the sides of a box the top and bottom of which are the metal surfaces (A). The sides are then gently pushed in with thumb and forefinger so that they fold as in (B). Now, at one end the metal top is pushed down to form an angle

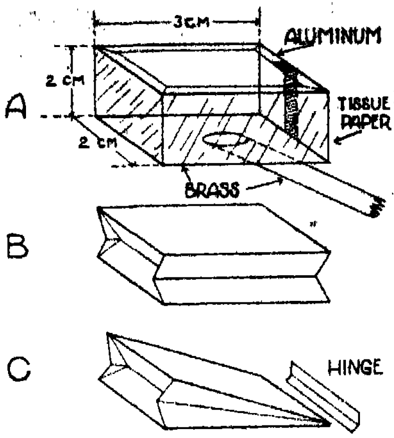

FIG. 1

with the base and a membrane hinge is cemented on (C). A writing lever (not shown in the illustration) is attached to the top surface. The bellows is now made ready for use by smearing generously a layer of paraffin oil on the membrane, thus not only sealing any microscopic holes, but rendering it more flexible.

These bellows may be made of any volume capacity to fulfil a particular condition of recording. It should be remembered that the more cubical the bellows is made, the more amplitude will be recorded for a certain volume change, and thus it is more sensitive but has less mechanical advantage. A useful proportion is shown in the illustration.

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A SIMPLE FEEDING DEVICE FOR CULEX PIPIENS IN AVIAN MALARIA STUDIES

THE meticulous and rather laborious procedures required for satisfactory continuance of the mosquito-canary propagation of plasmodia in the laboratory suggest that any simplification of methods should be placed on record. The accompanying rough sketches show a device which has been very helpful in my own work through (1) eliminating the possibility of loss of mosquitoes by the toppling of a lantern globe off a Petri or crystallizing dish, and (2) providing a "bed" in which the bird lies very comfortably, indeed often quietly asleep, while the mosquitoes are feeding. There are, as shown, three simple parts to this device: first, a round flat base cut with shears from light-weight galvanized iron and having four projecting portions turned up at right angles, two of these latter supporting upright hooks of stiff wire soldered against their outer surface; second, a small piece of rubberized cloth with a hole cut in it eccentrically; and, third, a rubber band. Without cloth, the band stretched between the two hooks holds the globe and dish securely together; for blood feeding, the cloth is slipped beneath the strands of the band, the bird is laid between the strands with its bared pectoral region over the hole and the two sides of the cloth are brought together on top and held in place by a pin.

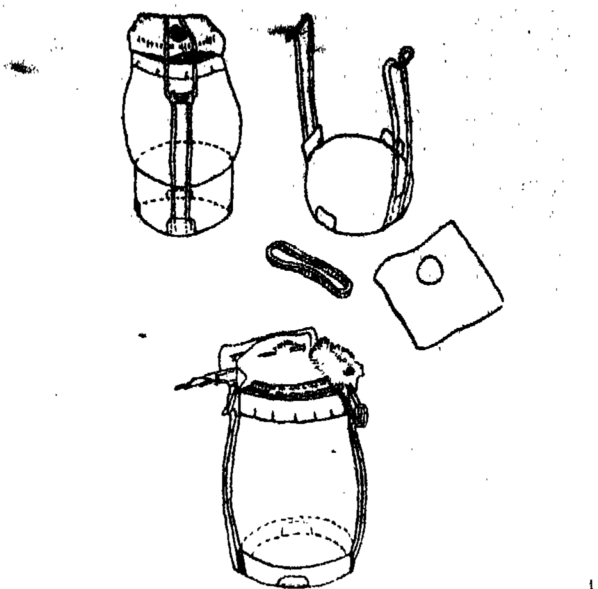

FIG. 1. A simple feeding device for *Culex pipiens* avian malaria studies.

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PHYSICS AND THE FUTURE[1]

By Professor ARTHUR H. COMPTON

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As the conversation turned to the problems faced by our children, my table companion was confident of the future. "During their generation," she asserted, "life can not change as it has for us. Experience will once more be usable as a reliable guide."

If advances in our mode of life are to cease, will it not be the result of a stagnation of our knowledge and techniques? Let us see what present trends indicate with regard to the direction and extent of such future changes.

No better guide can be found to the future than a review of what has happened in the past. Let us accordingly examine the trend of physics through history. Taking the broad view that the science of physics is concerned with the applications as well as the principles of mechanics, heat, electricity, etc., it will be seen that such a review must consider also the growth of techniques and inventions, for these embody some of the most important scientific advances.

In his recent book, "Science and the New Humanism," George Sarton has emphasized the fact that science is almost the only aspect of human activity which shows a definite and continuous growth throughout history. Though advances in other fields have occurred, they have come for the most part as a result of development of techniques based on growing science.

We are accustomed to speak of the stone age, the bronze age, the iron age and the machine age. This sequence reviews in quick outline the growth of man with regard to the tools with which he has done his work. Each stage has been ushered in as some inquirer, more persistent or more fortunate than his predecessors and building on the foundation of their techniques, has learned some new facts regarding the properties of matter, the chemistry of metals or the laws of mechanics. Such mechanical inventions are not the only ones. Language and writing are among the most significant inventions of all, giving as they do means of communicating ideas, carrying on abstract thoughts and remembering happenings with definiteness. When the invention of printing, telegraphy, the telephone, radio and moving pictures are added, it becomes possible for people to share thoughts widely, to become quickly aware of what is happening to all mankind and to "remember" what has happened to men in the past. Thus the world becomes almost a conscious unit, very similar to a living organism. So even the non-mechanical inventions have found their most effective application through the aid of scientific developments.

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[1] Based on a paper read at Ottawa, June 29, before the American Association for the Advancement of Science.

Hand in hand with this development of invention has gone the increase in our knowledge of nature. The properties of matter had to be learned before tools could be fashioned. Knowledge of the forest to the hunter, of soil and weather, grains and animals to the farmer, these formed the science of primitive life. Then, as now, new discoveries, that wood could be set on fire, that a moving magnet would produce an electric current, made possible improved conditions of life. Likewise, improved techniques opened the door for new knowledge. Skilfully made lenses made possible a telescope, and Jupiter was found to be a miniature solar system. As high vacuum pumps were developed, x-rays were discovered, and with them came new knowledge of the structure of matter. "If I saw farther, 'twas because I stood on giant shoulders," is the statement ascribed to Isaac Newton, who clearly recognized the way in which one advance makes possible another.

The result has been an increase in the rate of growth of knowledge and of the control of nature which is one of the most striking phenomena of man's history. When old knowledge was passed on by tradition and new knowledge came by accident, progress was slow. The ancient thought he did things as they had always been done, for the changes during one's lifetime were imperceptible. With the modern era came a fundamentally new concept. Now we search for new knowledge, and use it for "enlarging the bounds of human empire." The knowledge of nature which from the beginning had been man's gradually but accidentally increasing heritage has now become the conscious objective of alert minds. Three centuries ago the hobby of a few amateurs, this enterprise of science has gradually become the most significant intellectual quest of man. As a result, changes for the better in our mode of living are the order of the day. Our life differs from that of two generations ago much more than did that from the life of two thousand years before.

To see the cumulative effect of this advancing knowledge, it is instructive to use the historian's device of compressing the time scale, shall we say by a million fold. We may then think of the first men as learning a year or two ago to use certain odd-shaped sticks and stones as tools and weapons. Sounds took on meaning, and speech appeared. Last week some one developed the art of skilfully shaping stones to meet his needs. Man became an artist, and by day before yesterday he had learned to use simplified pictures as symbolic writing. Yesterday the alphabet was introduced. Bronze was the metal that was most used. Yesterday afternoon the Greeks were developing their brilliant art and science. Last midnight Rome fell, hiding for several hours the values of civilized life. Galileo observed his falling bodies at 8:15 this morning. By ten o'clock the first practical steam engine was being built. At eleven the laws of electromagnetism were developed, which by eleven thirty had given us the telegraph, electric power, the telephone and incandescent electric light. At twenty minutes to twelve, x-rays were discovered, followed quickly by radium and wireless telegraphy. Only fifteen minutes ago the automobile came into general use. Air mail has been carried for hardly five minutes. Not until the last minute have world-wide programs broadcast by short wave radio become popular. Now at noon we find mankind in a wholly new sense unified by science.

Science has thus become the basis of civilization, and is the primary factor in promoting its growth. During recent years it has been the science of physics whose activity seems to have been most significant in this regard. Just as earlier society was based upon agriculture and local trade, so modern communities are built upon the scientific foundation which makes possible rapid transportation and communication, the preservation and distribution of food and adequate sanitation. With only primitive knowledge of metallurgy, mechanics, electricity, chemistry and hygiene, our cities could not exist; and with them gone, country life also could have only a primitive form. It is on this basis that the president of the Massachusetts Institute of Technology has made the claim that in the last fifty years physics has exerted a more profound influence in changing all aspects of life than has been exerted in a comparable period by any other agency. The development of previous ages has grown to a mighty crescendo, within which we are living.

The growth of this scientific activity may be thought of as an aspect of social evolution. It supplies the knowledge which enables men to use the materials of nature for supplying their wants. The process involves specialization of function, which enables certain men to acquire extraordinary knowledge and skill in special fields. One important aspect of this process is the recent establishment of research laboratories. We have noted how the growth of knowledge, which had been mostly of an accidental nature, became with the modern era of science a primary objective of professional research men. Astronomical observatories and industrial research laboratories have pointed the way. In no field have these investigators proved their value more conclusively than in physics and the allied techniques. We may thus state with assurance that during the coming generation research in physics will continue with more and better trained investigators, with better organization and equipment, than during the past generation. We should accordingly expect an increasingly rapid growth of physical science, except in so far as the law of diminishing returns may make research effort less productive than during the past generation.

PRESENT TRENDS IN PHYSICS

By surveying one after the other the various fields of physics, we may gain some idea of the new advances that may be expected. In its fundamentals, physics is concerned with the relations between time, space and matter. During the past thirty years, remarkable advance has been made with regard to our understanding of our own position in space and time.

Two generations ago we had just become aware that the earth and life on it had existed for a very long time as measured in terms of the human life span. Since the development of radioactive methods of time measurement, we have been able to date the formation of rocks with precision and to assign a reliable though rough estimate of some billions of years to the age of the earth. In fact, the age of the universe itself, as shown by the stars and galaxies studied by powerful telescopes, has been put under searching scrutiny. Theoretical estimates have varied from an eternal universe to one whose duration has hardly exceeded that of the earth. There is little doubt but that within the next thirty years our information on this point will have been made much more reliable and precise. That is, we may hope to find out when the world was made.

In tracing man's origin to the Miocene age of more than a million years ago, and the origins of civilization to some five thousand years B.C., the geologists and archeologists have made important contributions to the physicist's problem of measuring time and enabling man to understand his own position with relation to the time scale. It thus becomes clear that an adequate consideration of "science and the future" must include a consideration of a future extending not only into thousands but possibly into millions of years.

One of the major technical achievements of the past century has been the great reduction of time required to communicate ideas and to accomplish desired ends. Fast mail, the telegraph, telephone and radio—these have enabled people for the first time to act and think in unison. At last it is possible for men the world over to act as a social unit if they so desire.

Not the least significant in this direction is our increasingly accurate control of time. Galileo's invention of the pendulum clock was an important step in this direction. The recent wide-spread introduction of electric clocks using accurately synchronized alternating current and of precise time signals broadcast by radio at frequent intervals have made practicable the planning of our daily lives according to more definite schedules. Precision electric and pendulum clocks are now timing the earth's rotation to study its irregularities. In ultra-short wave radio, time intervals are measurable in trillionths of a second. In atomic physics we are concerned with processes whose duration varies from more than a billion years down to less than a billion trillionth of a second.

In a similar way we may trace man's increasing understanding and control of space. Perhaps nothing has had more influence on man's attitude toward nature than the gradual unfolding of the immensity of the world. Starting with Galileo's discovery of the moons of Jupiter, which gave the first convincing evidence of the truth of the theory that the earth revolves about the sun, our known universe has now been extended to hundreds of millions of light years. Because of a change in the energy of the light from these far spaces it would seem that our knowledge will be forever limited to distances not much greater than are now known. In this sense at least we may consider our universe as finite, and in spite of telescopes of increasing size we need not expect the future to open to us much vaster vistas. Here, on the side of the very large, is thus placed a natural limit to future scientific advance.

Similarly in the field of the very small, though size alone gives no insuperable limit to our knowledge, both experiment and theory agree in indicating that the measurement of motion of objects must become less precise as their size becomes smaller. This means that we do not hope to be able to predict exactly what will happen to particular atoms. Statistical predictions of the average of many trials is all that can be hoped for. It is possible that this limitation may be of importance in the application of physics to certain problems concerned with the action of living organisms.

These examples suggest that there are fields of knowledge which may be forever beyond our ken. It would not be surprising to find other similar limits presenting themselves, as researches in other directions become more far-reaching. Thus there has been, in the last thirty years, no significant advance in the precision of ordinary distance measurement since Michelson's calibration of the standard meter in terms of light waves to one part in several million.

It is unnecessary to consider the manner in which rapid transportation is giving us increasing control of distance. Nor need we emphasize the increasingly accurate construction and measurement of manufactured articles. These important trends have shown such value that there is no doubt of their continuation and extension.

We may properly include as a major trend in physics the increasing control of large and small masses in manufacturing operations. The building of gigantic ships and bridges with reliably calculated strengths represents one extreme. Milady's miniature watch or the biologist's micromanipulator for dissecting individual cells is the other. Though these trends will doubtless continue, it is not to be expected that along this line the next century will show an advance comparable with that of the last. When objects are of dimensions of the order of a thousand feet, gravitational forces become of such importance as compared with cohesive forces that further increase in size becomes rapidly more difficult. By using steel of the highest tensile strength, such spans as the Golden Gate bridge become possible. Light alloys should extend the limiting size somewhat; but nature has set a limit to the distance between supports of objects, which at best is roughly five or ten miles, and for most forms of objects is much less.

Similarly, we are already working with things so small that their molecular motions are appreciable. Molecular bombardment is now a limiting factor in the precision of electrometers and galvanometers, so that further decrease in size is of little value. For scientific work, including living cells, metallurgy, atomic studies, etc., there is, however, much to be gained by further emphasis on observing and handling microscopic masses.

Corresponding to the extension of our knowledge of distances, there is a similar extension in our knowledge of masses. It was almost two centuries ago that Cavendish weighed the earth and thus made possible the measurement of the masses of the sun and planets. Only within the last generation has it become possible to estimate reliably the amount of matter in our galaxy. We can even begin to guess with some confidence the mass of the knowable universe. Similarly since 1900 precision methods have been developed for weighing molecules, atoms and sub-atomic particles, even including that most elusive of objects, a single ray of light. Having thus weighed the largest and smallest of things, further extension of this art must be in the direction of refinement and simplicity of measurement.

These developments in our knowledge and control of time, space and matter constitute the growth of the fundamentals of physics. Only a brief mention can be made of modern trends in the more detailed aspects of the science.

Both physics and chemistry are concerned with developing materials with desirable properties. The recent great advances in this direction will doubtless be discussed by Professor Urey. The dynamics of moving bodies, which from the time of Galileo to the present century had been primarily of academic interest, has with the use of the automobile become an essential part of everyday knowledge. With the development of aerodynamics, hydrodynamics has likewise received new impetus.

Perhaps the most significant mechanical advance of the last century, however, was the development of sources of power, steam and gas engines and water turbines. The efficiency of conversion of potential and chemical energy into useful work by these engines has increased from an original few per cent. to a value so high that though further advances are possible they can not greatly alter the power situation. We are favored for the time being with plentiful supplies of fuel in coal and oil. Within a century petroleum will have to be extensively supplemented by artificial liquid fuel, a procedure already followed in Europe. Within a thousand years the more readily available coal will be approaching exhaustion. New sources of power will thus gradually become of importance. Sources now available include agricultural products, such as wood and alcohol, water power, wind power and direct solar heat. Of these, perhaps that of agricultural products has the greatest promise of becoming a major power source. It is apparent, however, that unless fundamentally new developments occur, future generations will not be as favored as we are with regard to available power.

One of the major problems of the physics of the future is thus to investigate all sources of energy which show promise of being important. A hopeful lead is the inexhaustible flow of energy from the sun and stars in the form of radiant heat. Geological records indicate that for a billion years the sun has poured heat upon the earth at about the same rate as it now comes to us. Chemical energy, such as coal burning in oxygen, could not supply this power for more than a thousand years before the sun would cool. Within the last twenty years several theories of stellar heat have been put forward, the most promising of them based upon atomic nuclear reactions similar to radioactivity. In the laboratory, it has been found that such nuclear reactions can be produced and are capable of supplying heat in the necessary amounts. We do not yet know, however, how these nuclear reactions are made to occur efficiently on the sun, nor have we any assurance that they can be brought about on earth in such a way as to act as a source of energy.

Our situation in this regard is similar to that of the primitive man who felt the pleasant warmth of a forest fire, but had not learned how to keep the fire alight, much less how to kindle it. We know the desired energy is present on the earth. We hope to learn how to make it available to man.

There is thus no reason to be pessimistic with regard to power supply. It may require a decade, a century or a thousand years, but there appears no reason to fear man's inability to find an adequate new supply before the failure of power sources now developed limits the advance of society.

It is evident that we have only begun to appreciate the many uses of power. Heat, artificial light and running water have become almost universal in this country. Refrigeration, including air conditioning, is rapidly expanding its usefulness. Electric power and heat in the home, power for transportation and for industry—here is a trend that is upward, with no limit now in sight. The trend in the electrical distribution of power seems to be toward placing power plants near sources of fuel or water power, and transmitting the energy by high tension. Here physical problems of electrical insulation and electrical resonance are involved. Great improvements in high voltage insulation and very possibly use of direct current will make possible much farther transmission at much higher voltages.

The efficiency of electrical motors, generators, transformers and heaters is already so nearly perfect that further improvements in this direction are unimportant. There is considerable room, however, for improvement in the efficiency of electric lighting. Though notable advances have been made within the last generation, it remains theoretically possible to produce more than ten times as much white light for a given expenditure of power than is now given in ordinary house lighting. The fluorescent lighting now being introduced marks another important step toward high efficiency lighting; but more remains to be accomplished.

Special mention should be made of the physicist's studies of low temperatures, using liquid helium at fractions of a degree above absolute zero. Here the ordinary physical properties of elasticity, heat capacity and electrical conductivity are greatly altered. Recent developments have made this extreme cold accessible without great difficulty. We have not yet found important industrial uses for such low temperatures, but there is good reason to anticipate significant scientific advances from studies in this field.

It would appear that optical instruments have approached close to the limit of their technical development. The wave structure of light prohibits appreciably higher optical resolution than is attained by present instruments. Rapid development is, however, in progress in the understanding and use of rays of other wave-lengths. Within the past fifteen years the complete spectrum of electromagnetic waves, from the longest wireless waves, through heat rays to light, and on from ultraviolet to x-rays, gamma rays and cosmic rays, has been explored. In the short-wave regions of ultraviolet and x-rays, and in the long-wave regions of infra-red and radio waves, efficient radiators are available, and the properties and possibilities of the rays are well understood. There remain, however, intermediate regions, especially that of waves from a millimeter to a centimeter in length, which hold significant scientific and practical possibilities, which have not been developed.

Closely associated is the question of communication. Every stage of this advance has followed upon some fundamental discovery in physics. The work of Oersted, Ampere and Henry on the magnetic effect of the electric current led directly to the telegraph. The electric waves of Maxwell and Herz made possible Marconi's wireless. Radio broadcasting had to await the electron tube of Richardson and de Forest. The photoelectric cell is essential to television. There remains great room for advance in this field, using the physical laws and techniques now understood. One can not predict what new principles may appear which will bring about further epochal changes.

There are many professional physicists who are not at all concerned with the practical applications, but solely with the fundamental principles of their science. The understanding of the physical world is their objective. Within the last half century they have found the atoms postulated by Democritus two thousand years ago and have learned much regarding their structure and properties. Sub-atomic particles have also been found and investigated, electrons, positrons, neutrons, photons, barytrons and neutrinos, the building blocks of which the world is made. Some of these particles are known only as visitors, coming to us as cosmic rays from remote space. Their masses and electrical charges are known. When these particles approach each other at very short distances, new kinds of forces have been found, which overpower the ordinary electrical and gravitational forces.

Similarly, the physicist looks outward. He finds with Einstein that for rapidly moving planets a slight modification of Newton's law of gravitation is necessary. At distances greater than the diameter of our galaxy there apparently appears a repulsive force which becomes greater than gravity and makes galaxies fly apart.

He suspects his laws of electrodynamics and of the conservation of energy, and subjects them to more searching tests. For this work no laboratory particle has sufficient energy. He must use a cosmic ray with a thousand times the energy that he can develop by electrical methods.

THE GROWING INFLUENCE OF PHYSICAL DISCOVERIES

If such a physicist can appreciate more adequately his place in the world and why things are as they are, he has a sufficient reward for his effort. This knowledge forms an essential part of man's cultural heritage. Yet its importance is also great in shaping men's lives. Its significance in this regard can perhaps be best indicated by citing examples. Consider the discovery of electromagnetic induction by Faraday and the discovery of x-rays by Roentgen.

Faraday's discovery was considered a century ago as a purely scientific curiosity. It was recognized that here was a means of producing an electric current, and laboratory generators were made. But why should the public be interested in electric current? It was fifty years later, when Edison showed the value of electricity in lighting houses, that the importance of Faraday's discovery began to be evident. With regard to the effect it has had upon the lives of men, it is, I believe, demonstrable that the discovery of electromagnetic induction was the most important event of the nineteenth century. Empires would fall apart, society would become disorganized, if the electrical machines based upon Faraday's discovery were put out of commission.

Roentgen's discovery was made within the lifetime of most of those listening to this address. What could be of more purely academic interest than extending the spectrum of electromagnetic radiation to a thousand-fold shorter wave-length? That was Roentgen's achievement. I have tried to think of the most important event that has happened in my lifetime. Perhaps it was the world war. Let us then compare the consequences of Roentgen's quiet announcement of x-rays in 1895 with those of the dramatic events which in 1914 plunged the world into war. Let us speak in terms of human values, life and death, attitudes, means of living, the organization of society.

First consider death. Such data are hard to find. The war lords do not want them advertised. I have, however, recently looked up the figures. In the world war there were about 8½ million soldiers killed in all the armies, one fourth of the able-bodied men now living in the United States and Canada—a tremendous slaughter. Yet of the 450 million people then living in the countries at war, some 50 million will have died of cancer. The lives of some three million others will have been saved from cancer by the use of x-rays and the radium which was discovered as a result of x-rays. If you add to these the considerably greater number whose lives have been saved by the x-ray diagnosis of tuberculosis, a broken bone or an infected tooth, it becomes evident that even in the warring countries x-rays will have saved as many lives as were taken in battle.

"But," I hear you saying, "what of the vast political and economic disturbance caused by the war?" X-rays have also had their great economic and political effects, not so dramatic, but perhaps even more far-reaching. What does it mean to the economic and political life of the United States to be integrated by radio? For one thing it means that we are a unit of governable size, with no apparent tendency toward disintegration. It means nation-wide markets for centrally produced and advertised goods. Yet without x-rays, no radio. For the radio is the child of the electron, and the electron owes its recognition to the ionization of air by x-rays. Similarly, were it not for x-rays we should not now have sound movies or long-distance telephony or radio beacons to guide air mail or a multitude of other devices that rely upon electrons for their operation.

But the real significance of such a discovery as x-rays is much deeper. Physics lay stagnant. "The future lies in the next decimal place," was the current phrase of the day. With it inactive, other fields of science were also developing but slowly. For twenty years the idea of ions had been making poor headway in chemistry and physics. The announcement of x-rays kindled a tinder box. Never perhaps has history shown such an outburst of scientific activity. Thousands of investigators set themselves to study the newly opened possibilities. Within a few months came the announcement that x-rays dissociate air and other gases into charged ions, and chemistry had the impulse that was needed to start it on its phenomenal modern growth. Another few months, and radioactivity was discovered, leading to radium and all its consequences. Another year or two and electrons became known. The atomic theory was now on a firm basis, but the atom itself was found to have a structure. Not an important field of science but was stimulated by these developments. The geologist had placed in his hands a radioactive clock for measuring the ages of his rocks. The biologist was given an artificial method of producing mutations, changing species at will. The psychologist received electron tubes for measuring nerve currents. The scientific world was set aflame. While many advances would have occurred without Roentgen's discovery, its appearance greatly stimulated these advances. One may say that the modern scientific era was ushered in by x-rays.

If science has come to have a determining place in our economic, social and intellectual life, it is because of such discoveries as this. Strictly speaking, one such achievement should not thus be singled out as if it alone had caused these transformations; for the whole body of science is closely interrelated. Roentgen's discovery is rather to be compared with a declaration of war which initiates a whole series of world-shaking events. On this basis, as seen after forty-three years, the discovery of x-rays is thus quite comparable with the starting of the world war.

But here is a vast difference. The scars of the great war are rapidly healing. New alliances are being formed. Future wars are being planned and old ones forgotten. Science's achievements, on the contrary, are of growing significance. Recent discoveries have not yet shown their human worth. Had we used Faraday's discovery of electromagnetic induction instead of the much later one of Roentgen, our comparison with the world war would have been too one-sided. Electrical machinery is vital to the world's existence. Industrially, politically or socially, it is now far more significant than the result of any past war. We have seen the growing value of the discovery of x-rays. A century from now, when the world war means no more than the pages of history describing Napoleon's conquests mean to us now, x-rays and the developments consequent upon it will have become of a significance comparable with that of electricity to-day. Physics and the future! All history demonstrates the growing value of scientific discoveries. Fire, the wheel, handling of iron and steel, the laws of motion and electricity, never have they meant as much to man as to-day. By the same token we can be confident of the permanent value of the scientific achievements of our own age.

In the past there have been alternating periods of rapid scientific advance and relative stagnation. There are now definite signs of a decline of physics research in central Europe; but the increasing interest in both fundamental and applied physics in other parts of the world indicates that this decline is a local rather than a world trend. The Orient has joined the Occident in physics research. India contributes to our knowledge of scattered light and of stellar atmospheres; China interprets atoms by scattered x-rays; Japan develops iron with new magnetic properties. British research is carried on throughout the empire. Mexico joins effectively in the study of cosmic rays. With physics research now truly world-wide, the future advances can hardly be greatly affected by local political disorders. On the other hand, we may continue to expect periods of relative stagnation following the solution of problems that occupy the attention of leaders of the science. This was the situation in physics toward the close of the nineteenth century after classical mechanics and electrodynamics had been developed, and again in 1930 for a brief period, following the development of quantum mechanics. Very probably similar quiescent stages will follow the solution of the major problems of nuclear physics and cosmic rays. As before, however, these quiescent stages should be only temporary, for many physics problems remain to be solved and the rewards for their solution are great.

PHYSICS AND A STABILIZED SOCIETY

The growth of physics is thus intimately bound to the future of civilization. Advances in science and techniques go hand in hand, and both become easier in a well-organized society where specialists can develop highly specialized skills. It is thus impossible to conclude an adequate statement about physics and the future without some consideration of the mutual relation between physics and the organization of society.

It has become clear to all who have their eyes open that the great power given to man by his new knowledge of the world may be used either to his good or to his harm. Without cooperation, we have seen that this knowledge can not be made fully effective. If men divide into antagonistic groups it may become terribly destructive. When it becomes sufficiently evident that the welfare of the more powerful communities depends upon cooperation rather than upon strife with others, we may expect such cooperation to be not far distant. The growth of physics, through its great advances in communication, its highly specialized and interdependent industries, and the great power given to industrially organized communities, is rapidly bringing about just this condition, where strife endangers every one and cooperation gives rich rewards to all. Thus, not only does physics need well-organized civilization for its own development, but it is in itself a powerful factor in stabilizing such a cooperative society.

OBITUARY

FRANK BURSLEY TAYLOR

Frank Bursley Taylor was born in Fort Wayne, Ind., on November 23, 1860, the only child of Judge Robert S. and Fannie Wright Taylor. His father was nationally known as a master of law in cases involving electrical sciences and a man of superior talent and broad interests. Taylor was graduated from the Fort Wayne High School in 1881, but because of poor health he deferred entering Harvard University until 1882. He there took an elective course seeking no degree, and gave especial attention to geology and astronomy for two years, being much interested in their lines of contact.

In order to gain more vigor, Taylor then traveled with a physician as companion quite widely in the upper Great Lakes region, giving attention to high shore lines and former lake outlets. His family spent their summers on Mackinac Island, and the first contribution he made to geologic literature was a paper on "The Highest Old Shore Line of Mackinac Island," published in the *American Journal of Science* in April, 1892. This was followed within the next two years by several papers in the *American Geologist*, covering results of his reconnaissance work in the Superior, Michigan and Huron basins. Having traversed what is now known as the Nipissing Outlet from Georgian Bay past North Bay to the Ottawa River, he interpreted it as a strait connecting Georgian Bay with the Gulf of St. Lawrence and published a paper on "The Ancient Strait at Nipissing" in the *Bulletin* of the Geological Society of America, Volume 5, 1893. Between 1895 and 1897 he extended studies southward in the Michigan and Huron basins and gave attention to moraines as well as shore lines.

Up to 1900 Taylor had conducted investigations at private expense. He then became connected with the U. S. Geological Survey, and for several seasons did detailed mapping of moraines and shore lines as an associate with the writer in Michigan and neighboring parts of Indiana and Ohio, the results of which are presented in Monograph 53, U. S. Geological Survey, published under our joint authorship in 1915.

In 1908 and 1909 Taylor worked under the auspices of the Geological Survey of Canada in the southern part of Ontario, making a hurried reconnaissance of a wide area, and giving attention to moraines as well as shore lines. The results appear in the *Transactions* of the Canadian Institute for 1913 under the title "The Moraine Systems of Southwestern Ontario." He later made a special study of Niagara Falls, on which is based "The Niagara Folio,"[1] published in 1913. He also spent one or two seasons under the auspices of the U. S. Geological Survey in field work in Massachusetts and Connecticut in an attempt to work out the method of recession of the Wisconsin icesheet.

About 90 titles of papers and reports by Taylor are listed in the Bibliography of North American Geology between the years 1892 and 1934. Several papers deal with subjects on the border line of astronomy and geology. They discuss the origin and growth of satellites and planetary systems; tidal forces and horizontal sliding of continental crust sheets; the preeminence of Asia in Tertiary diastrophism, etc. Because of these papers, Daly and others have coupled Taylor's name with Alfred Wegener's and made references to "The Taylor-Wegener Hypothesis" as if their views were similar or harmonious. This was a source of regret by Taylor, as he did not subscribe to the Wegener hypothesis of a drifting of continents by flotation.

Aside from his scientific work, Taylor was much interested in artistic and literary subjects, and was a member of the American Academy of Arts and Sciences. He served as president of a Fort Wayne art school, of the Allen County, Indiana, Historical Society and of the Fortnightly Club. He was thus a guiding spirit of the community.

He married Minetta Ketchum, of Mackinac Island, in April, 1899, who survives him. Mrs. Taylor has been a constant participant in all his work. In much of the field work it was she who drove the team, and later the auto, giving him freedom for observation and notes. Thus with her help his delicate health ceased to be much of a handicap, and he was able to cover a large field in a creditable manner. His death occurred on June 12, 1938, after an attack of coronary thrombosis on June 10.

FRANK LEVERETT

RECENT DEATHS

DR. CHAS. H. HERTY, research chemist in charge of the Pulp and Paper Laboratory of the Industrial Committee of Savannah, Georgia, died on July 27 in his seventy-first year.

DR. TRUMAN MICHELSON, since 1910 ethnologist of the Bureau of American Ethnology of the Smithsonian Institution, died on July 26 at the age of fifty-eight years.

DR. G. M. JOHNSTONE, MacKay director of research at the Stamford, Conn., laboratories of the American Cyanamid Company, died on July 29 at the age of fifty-five years.

MRS. YNES MEXIA, of Berkeley, Calif., botanical collector, died on July 12 at the age of fifty-eight years.

FRANK M. BAUER, president of Pfaltz and Bauer, Inc., dealers in chemical apparatus, New York City, died on July 20.

Nature reports the death of Dr. A. E. H. Tutton, an authority on chemical and physical crystallography, formerly H. M. inspector of schools, Technological Branch, British Board of Education, on July 14 at the age of seventy-three years; of Sir Colin Mackenzie, formerly director of the Australian Institute of Anatomy, aged sixty-one years, and of H. N. Thompson, lately director of forests, Nigeria, on July 9.

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[1] Folio No. 190, U. S. Geological Survey.

SCIENTIFIC EVENTS

THE ALBERT FARWELL BEMIS FOUNDATION

DR. KARL T. COMPTON, president of the Massachusetts Institute of Technology, has announced the establishment of the Albert Farwell Bemis Foundation, dedicated to the advancement of housing for the benefit of the public and of the building industry. The purpose of the foundation will be to search for and disseminate knowledge pertaining to adequate, economical and abundant housing.

The establishment of the foundation has been made possible by a grant from the Albert Farwell Bemis Charity Trust, the trustees of which are Farwell G., Alan C. and Judson Bemis, sons of the late Albert Farwell Bemis, of Boston. The new foundation is a memorial to their father, who died in 1936.

The foundation, which will be a separate division of the institute, perpetuates the life-long interest of Mr. Bemis, who believed, after many years of pioneering studies, that better and more economical housing could be achieved only through improvements in the technology of building.

The foundation will be directed by John E. Burchard, of Winchester, who for several years has been vice-president of the Bemis Industries, Inc., where he was closely associated with the late Mr. Bemis in research on housing and the utilization of housing materials. Mr. Burchard will begin his work as director of the foundation in September.

The foundation will cooperate with various departments of the institute, especially the departments of architecture and civil engineering, and the division of industrial cooperation, the three departments whose work most closely approaches that of the foundation.

The major policies of the foundation will be determined by the president of the Massachusetts Institute of Technology with the counsel of an advisory committee, the members of which will be men prominent in the architectural and building professions.

The general program will include:

Coordination of the available knowledge on materials, construction methods and the economics of shelter.

Stimulation and planning of research in various phases of the building industry.

Dissemination of information on its various activities for the greatest benefit of the public and the building industry.

Cooperation with all departments of the institute in making available the latest material on housing for undergraduate and graduate instruction in the institute.

As a central organization for the study of housing, the foundation is expected to play an important part indicating and preparing for research fundamental problems the solution of which will contribute notably to the technological advancement of building. Other problems involving the economics of housing are the transportation and distribution of building materials, studies of the effect of mass production in those portions of the building industry where this technique has been applied, analysis of the cost of existing houses in terms from which conclusions may be drawn; land development studies; studies of building costs in terms of maintenance. The entire field of building materials may also be of interest to the foundation, particularly the behavior of building materials in combination as opposed to their behavior individually. The foundation plans to publish the results of its activities at such times and in such form as will be of the greatest assistance to the public and to industry.

THE PROPOSED POLISH BALLOON FLIGHT INTO THE STRATOSPHERE

THE National Geographic Society, after a conference with members of the Polish Embassy staff, has announced that the next manned-balloon flight into the stratosphere will be made from Poland in September, under the auspices of the Polish army. The pilot will be Captain Zbigniew Burzynski, who has returned to Poland after a visit to the United States, during which he consulted with Major Albert W. Stevens, who commanded the stratosphere flight of the National Geographic Society and the U. S. Army Air Corps in 1935, and with specialists of the National Bureau of Standards, who designed some of the instruments used in the ascent.

The balloon, which is almost completed, will be considerably larger than the *Explorer II* of the Geographic-Army flight, and will be made of rubberized silk, which was both grown and processed in Poland. Its volume will be more than 4,800,000 cubic feet as against 3,700,000 cubic feet for *Explorer II;* the height at take-off time, 459 feet as against 315 feet, and the greatest diameter 209 feet as against 192 feet. In spite of this greater size, the bag will weigh only 3,300 pounds instead of the 6,350 pounds of *Explorer II,* owing to the lesser weight per square yard of the silk fabric. The spherical gondola to be used will be made of aluminum and steel.

Balloon and gondola together, ready for flight, will weigh less than half as much as *Explorer II,* so that it should reach a much greater height, probably 81,000 feet (15 1/3 miles) above sea level. *Explorer II* established the present world altitude record of 72,395 feet (approximately 13¾ miles), in an ascent from the Black Hills, near Rapid City, S. D., on November 11, 1935.

Captain Burzynski will be accompanied by Captain F. R. Hynek, also of the Polish Army, and Dr. Yodko Narkiewicz, Alpinist and explorer. In 1935 they established a record by remaining in the air fifty-seven hours and forty-five minutes, while flying from Warsaw into Russia. The flight will be made from a valley in the Tatry Mountains near Zakopane, in southwestern Poland near the Czechoslovakia border. Studies to be made will include cosmic radiation, pressure and temperature. Among the instruments to be used will be several loaned by the National Geographic Society which were used in the flight of *Explorer II* in 1935. Funds amounting to nearly $200,000 were raised by popular subscription.

Since the flight of *Explorer II* three attempts have been made to penetrate the stratosphere. On March 9, 1936, two Russians, ascending from Moscow, reached an altitude of 10,000 meters (about 32,808 feet) in a balloon of only 77,700 cubic feet capacity. On May 25, 1937, at Brussels, Professor Auguste Piccard's balloon caught fire from a gas burner used to heat air for lifting the balloon, as the ground crew were attaching the basket for the ascent of Piccard and Max Cosyns. On July 18, 1937, Professor Jean Piccard took off at Rochester, Minnesota, in a gondola lifted by a group of small balloons and, six hours later, crashed into the treetops near Lansing, Iowa. He attained a height of 11,000 feet.

LECTURES GIVEN BEFORE THE DEPARTMENT OF PHYSICS OF CORNELL UNIVERSITY

DURING the academic year 1937–38 reports by non-resident speakers were presented at meetings of the faculty and graduate students in physics at Cornell University as follows:

November 1, "Molecular Beam Methods of Measuring Nuclear Moments," Professor I. I. Rabi, Columbia University.

November 22, "The Diffraction of Fast Electrons by Gas Molecules," Professor Linus Pauling, California Institute of Technology.

December 16 and 17, "The Dielectric Constant of Liquids and Solids and Ferromagnetic Anisotropy," Professor J. H. Van Vleck, Harvard University.

January 17, "Stresses and Constitutional Changes in Glass During Cooling," Dr. H. R. Lillie, Corning Glass Works.

February 14, "Some Vacuum Tube Research Problems," B. J. Thompson, R. C. A. Research Laboratory.

March 21, "Some Problems of Galactic Dynamics," Professor K. Lundmark, University of Lund.

March 24, "Transmutations of Heavy Nuclei," Professor V. Weisskopf, University of Rochester.

April 18, "Recent Work in the Cavendish Laboratory," Dr. M. Goldhaber, University of Cambridge.

May 9, "Some Physical Phenomena at the Temperature of Liquid Helium," Professor E. F. Burton, University of Toronto.

May 23, "Crystal Fluorescence," Dr. Frederick Seitz, General Electric Research Laboratory.

ORGANIZATION OF THE NATIONAL ASSOCIATION OF BIOLOGY TEACHERS

THE organization meeting of the National Association of Biology Teachers was held in New York City on July 1.

Fifteen delegates, representing approximately fifteen hundred pledged members in thirty-five states, adopted a constitution, elected officers and established a journal which will be known as *The American Biology Teacher*.

The purpose of the association as stated in the constitution is to organize biology teachers on a national basis by local units in order to spread vital and useful biological knowledge to the general public; to encourage scientific thinking and the scientific method, and through the journal to make available to biology teachers information concerning the selection, organization and presentation of biological materials.

The association is sponsored by the committee on biological science teaching of the Union of American Biological Societies, of which Dr. Oscar Riddle, of Cold Spring Harbor, N. Y., is chairman and Dr. D. F. Miller, of the Ohio State University, is field representative.

The officers of the association are as follows:

President, M. C. Lichtenwalter, Chicago, Ill.
President-elect, Malcolm D. Campbell, Boston, Mass.
First vice-president, George W. Jeffers, Farmville, Va.
Second vice-president, Lucy Orenstein, New York, N. Y.
Secretary-treasurer, P. K. Houdek, Robinson, Ill.
Acting editor-in-chief, I. A. Herskowitz, New York, N. Y.
Managing editor, J. S. Mitchell, Lexington, Ky.

Inquiries concerning membership and subscriptions to the journal should be sent to the secretary-treasurer, P. K. Houdek, Township High School, Robinson, Ill.

THE AMERICAN MEDICAL ASSOCIATION AND THE GROUP HEALTH ASSOCIATION, INC.

ACCORDING to reports in the daily press, the Department of Justice on July 31 charged the American Medical Association and its affiliate, the District of Columbia Medical Society, with violation of the anti-trust laws in an attempt to prevent the functioning of the Group Health Association, Inc. Thurman W. Arnold, assistant attorney general, has announced that evidence obtained in an investigation would be presented to a grand jury. The charges against the association are:

1. Threatened expulsion from the District Medical Society of doctors who accept employment with the group.

2. Threatened expulsion from the Medical Society of

doctors who take part in medical consultations with doctors of the group.

3. The expulsion from Washington hospitals of the Group Health Association staff doctors.

In the opinion given by Mr. Arnold he says:

> The department believes that the anti-trust laws make it illegal for medical societies or individual practitioners to obtain or retain for themselves a monopoly of the communities' medical services, so long as adequate standards are maintained in the treatment of patients among those doctors who are willing to serve cooperative or other groups.
>
> No combination or conspiracy can be allowed to limit a doctor's freedom to arrange his practice as he chooses so long as, by therapeutic standards, his methods are approved and do not violate the law.
>
> Organized medicine should not be allowed to extend its necessary and proper control over standards having to do with the science and art of medicine, to include control over methods of payment for services involving economic freedom and the welfare of consumers and the legal rights of individual doctors.

THE MARINE BIOLOGICAL LABORATORY AT WOODS HOLE

This year marks the fiftieth anniversary of the founding of the Marine Biological Laboratory at Woods Hole, Mass. In the summer of 1888 the first building was opened for the use of seven investigators (all save one were beginners), and eight students. Professor C. O. Whitman, of Chicago, was the director. The laboratory was scantily furnished with glassware and other necessities; living material was collected in a rowboat; the library consisted of a few volumes on a shelf, which also carried the supply of chemicals. During the half century which has followed, the institution has grown until the attendance is more than 500. To the original building, still used for investigation and research, have been added other wooden buildings, and a large brick laboratory containing a remarkably complete library, research rooms equipped with running fresh and salt water, well-stocked chemical and apparatus rooms, a very efficient x-ray installation and a large auditorium. The supply department now has power boats, a fish trap and other equipment needed for its very important task. In the past fifty years the institution has grown from a very modest beginning to a position of world-wide influence in biology.

At an informal meeting to celebrate the semicentennial of the laboratory, there will be presented a portrait of C. R. Crane, who in very large measure was responsible for the growth of the institution. Mr. Crane was president of the Board of Trustees from 1902 until 1925; he gave a completely equipped laboratory building in 1914, and later, a large sum for an endowment fund. His numerous gifts over a period of more than a generation have been substantial and timely. The Marine Biological Laboratory has received large gifts also from John D. Rockefeller, Jr., the Rockefeller Foundation and the Carnegie Corporation.

From the first, the chief activities of the laboratory have been instruction and research. During the summer, courses are offered in invertebrate zoology; embryology, chiefly of the invertebrates; general physiology; protozoology, and marine algae. The attendance this summer is at a maximum, practically all the space devoted to instruction being occupied. A few changes have occurred in the staff of instructors. In the physiology course, Dr. Carl Schmidt has replaced Dr. Rudolf Höber; Drs. L. G. Barth and Charles Packard have resigned from the embryology staff, their work being taken by Dr. W. W. Ballard, of Dartmouth, and Professor D. M. Whitaker, of Stanford University. In the other courses the teaching staff is the same as last year.

Following a custom initiated by Professor Whitman, and never discontinued, members of the laboratory give weekly lectures in which they discuss their investigations. The first lecture of the current season was given by Professor M. H. Jacobs, the retiring director, who spoke on "Blood and Zoological Classification." Professor S. O. Mast, of the Johns Hopkins; Professor G. H. Parker, of Harvard; Dr. O. E. Schotté, of Amherst, and Dr. Eduard Uhlenhuth, of the University of Maryland, gave the other lectures in July.

Each week there is also a seminar devoted to the presentation of short papers by investigators at work in the laboratory. During July, the topics discussed were some phases of endocrine activity, protozoan studies, aspects of the physiology of muscle and the action of organizers in development. An important feature of these informal gatherings is the lively discussion which follows the presentation of the papers.

The aim of the institution was stated many years ago by Professor Whitman. "The Marine Biological Laboratory attaches itself to no single institution, but holds itself rigidly to the impartial function of serving all on the same terms. . . . The whole policy is national in spirit and scope. The laboratory exists in the interests of biology at large."

SCIENTIFIC NOTES AND NEWS

Dr. Earl Baldwin McKinley, professor of bacteriology, dean of the Medical School and director of medical research at the George Washington University, and Fred Campbell Meier, plant pathologist of the Department of Agriculture, were on the *Hawaii Clipper*, lost over the Pacific on July 28. They were engaged in research on aerobiology and in making arrangements for the continuation of the collection of micro-organisms, viruses, pollens and dust in the upper air by officers of the trans-Pacific airships.

AT the meeting of the Pacific Division of the American Association for the Advancement of Science, held in San Diego during the week of June 20, Dr. S. J. Holmes, professor of zoology of the University of California, was elected president in succession to Dr. J. S. Plaskett, director emeritus of the Dominion Astrophysical Observatory, Victoria, B. C. A full report of the meeting by Dr. J. Murray Luck, secretary of the division, will appear in an early issue of SCIENCE.

WESLEYAN UNIVERSITY at commencement conferred the doctorate of science on Dr. Aaron L. Treadwell, of the class of '88, now professor emeritus of zoology of Vassar College.

THE doctorate of science has been conferred by the University of Belfast on Dr. J. P. Hill, professor of embryology of University College, London.

Nature reports that Sir William Bragg, president of the Royal Society and director of the Royal Institution, has been elected a foreign associate of the Paris Academy of Sciences. The number of foreign associates of the Paris Academy is limited to twelve; the only other British foreign associate is Sir Joseph Thomson.

DR. WOLFGANG OSTWALD, professor of colloid chemistry at Leipzig, and Dr. Erich Martini, professor of medical zoology at Hamburg, have been nominated as honorary members of the Rumanian Academy of Sciences at Bucharest.

THE yearly prize of the International Veterinary Congress at its twelfth annual meeting in New York City was awarded to Dr. George H. Hart, professor of animal husbandry in the College of Agriculture of the University of California, "for the most outstanding work of the year in veterinary science."

AT a meeting on July 14 of the Royal College of Surgeons, London, Dr. Hugh Lett was elected president for the ensuing year. At the same meeting the Hallett Prize was awarded to Dr. Howard Hadfield Eddey, of the University of Melbourne.

THE American Society for the Study of Allergy has elected the following officers for 1938–1939: *President*, Dr. Harry L. Alexander, St. Louis, Mo.; *President-elect*, Dr. Warren T. Vaughan, Richmond, Va.; *Vice-president*, Dr. Robert L. Benson, Portland, Ore.; *Secretary-Treasurer*, Dr. J. Harvey Black, Dallas, Texas. The 1939 meeting will be held at St. Louis, in conjunction with the meeting of the American Medical Association.

PROFESSOR JOHN C. GRAHAM, for twenty-seven years head of the department of poultry husbandry of the Massachusetts State College at Amherst, retired at the close of the academic year.

DR. ELLIOTT L. MCMILLEN, assistant professor of chemical engineering at the Iowa State College, has resigned to become head of the department of engineering of Lafayette College, and Dr. Grover L. Bridger, of the department of chemical engineering, has been appointed assistant professor of chemical engineering at the Rice Institute.

DR. WALTER W. WISNICKY, for the last eight years director of livestock sanitation with the Wisconsin State Department of Agriculture and Markets, has been appointed professor of veterinary science at the University of Wisconsin. He has obtained leave of absence from his present work and will join the faculty on August 15.

IN the department of physics of Indiana University, Dr. F. N. D. Kurie, research associate at the Radiation Laboratory of the University of California, and Dr. E. J. Konopinski, national research fellow at Cornell University, have been appointed assistant professors. Dr. L. M. Langer, of New York University, has been made instructor.

DR. P. F. ENGLISH, of the department of forestry and wildlife management, has resigned from the Connecticut State College to accept an assistant professorship of wildlife management at the Pennsylvania State College.

GEORGE R. PHILLIPS, from 1926 to 1936 state forester of Oklahoma, has been made acting chief of the Division of State Forests in the U. S. Forest Service.

DR. R. W. ESCHMEYER, for the past eight years associated with the Institute of Fisheries Research at the University of Michigan, has become associate aquatic biologist with the Biological Readjustment Division of the Tennessee Valley Authority, and Earl Cady, of the Cleveland Museum of Natural History, also has joined the division, of which the headquarters are at Norris, Tenn.

WILLARD W. HODGE, professor of chemical engineering and head of the department of chemical engineering at West Virginia University and director of the Engineering Experiment Station, has been granted a year's leave of absence to conduct work at the Mellon Institute, Pittsburgh, Pa., on the prevention of stream pollution under a fellowship founded by the American Iron and Steel Institute. Dr. A. E. Alexander, ceramic engineer with the Electric Auto-Lite Company of Toledo, has been appointed industrial fellow in mineralogy and petrography.

DR. C. E. ZOBELL, assistant professor of marine microbiology at the Scripps Institution of Oceanography of the University of California, will spend next year as visiting professor in the department of limnological biology at the University of Wisconsin, where he will hold a research post-doctorate fellowship. He will work in association with Dr. E. B. Fred, Dr. Chancey Juday and other staff members.

LIEUTENANT COMMANDER LINCOLN ELLSWORTH sailed on July 26 for Southampton on his way to Cape Town, South Africa, for his fourth expedition to the Antarctic. It is expected that the expedition will leave Cape Town on October 1 on the *Wyatt Earp*. Sir Hubert Wilkins will be a member of the party.

AT the U. S. Geological Survey, Dr. Philip S. Smith, chief Alaskan geologist, sailed from Seattle, Wash., on June 20, to make the annual investigation of mining conditions and mineral production in Alaska. His first stop is at Juneau, Alaska, where he will join the party under John C. Reed, which is making geologic and topographic surveys on the west coast of Chichagof Island. In connection with the recent allotment of funds to the survey by the Public Works Administration, W. D. Johnston, Jr., left Washington on July 16 for Los Angeles and San Francisco, to organize parties to study manganese, chrome and mercury deposits in California, Oregon and Wyoming.

MEMBERS of the department of geology of Northwestern University who are conducting scientific work during the summer include Dr. Edward C. Dapples, who is studying the coal fields of England, France and Germany; Arthur L. Howland and Robert Garrels, who are investigating the iron ores of Newfoundland under the auspices of the Newfoundland Geological Survey; Dr. William E. Powers, who is in Ottawa, Canada, gathering material on the physiographic regions of Canada, and Dr. J. R. Ball, who is continuing his work on the Silurian epoch in Tennessee, Missouri and Arkansas. Dr. John T. Stark made studies in July of the Val d'Or gold field in Canada, and this month will conduct a field course in the Ontario-Minnesota boundary region.

DR. THOMAS J. LEBLANC, professor of preventive medicine at the University of Cincinnati, and five students are attending the regular summer course of four weeks at the School of Tropical Medicine, Puerto Rico. Dr. Howard B. Shookhoff, who holds a fellowship from the New York Academy of Medicine, plans to spend five months at the school.

DR. SAMUEL H. WILLIAMS, professor of biology at the University of Pittsburgh, has left for Port-au-Prince, Haiti, where he will study for about two months the archaic insect fauna in the interior.

DR. STIG RYDEN, of the Göteborg Museum, Sweden, is making a tour of the principal museums and ethnographical collections in the United States, following which he will go to Bolivia, where he plans to undertake ethnographical work.

THE fiftieth anniversary of the founding of the Storrs Agricultural Experiment Station at the Connecticut State College was celebrated on July 28. The following program, presided over by President Albert N. Jorgensen, was presented: "Milestones and Monuments—A Historical Sketch of the Station," by Director William L. Slate; "The Place of an Agricultural Experiment Station in the Economy of a Commonwealth," by Dr. R. E. Buchanan, director of the Iowa Agricultural Experiment Station; "Dreams, Goals, Deeds," by Dr. J. L. Hills, dean of the college of agriculture and director of the experiment station of the University of Vermont.

THE autumn sessions of the National Academy of Sciences will be held at the University of North Carolina on October 24, 25 and 26.

THE sixtieth meeting of the American Astronomical Society will be held from September 14 to 16 at the University of Michigan, under the presidency of Dr. Robert G. Aitken, director emeritus of the Lick Observatory.

THE eighteenth annual meeting of the Highway Research Board will be held in the building of the National Academy of Sciences and National Research Council, Washington, D. C., from November 30 to December 2.

THE U. S. Bureau of Fisheries has established an office at the Utah State Agricultural College, Logan, for the purpose of cooperating with the Forest Service in developing a stocking program for the lakes and streams of Forest Region No. 4. Dr. Stillman Wright is in charge of the office.

THE sum of approximately $37,000 to be spent over a period of five years has been given by the Commonwealth Fund, New York, to the University of Minnesota to be used for graduate medical education. The fund will provide for a series of advanced courses in at least five branches of medicine.

THE London *Times* states that an expedition, organized at the Scott Polar Research Institute, is visiting West Spitsbergen this summer. The object of the expedition is twofold. The nature and processes of glacial erosion will be investigated in conditions resembling those which prevailed in Great Britain during the Ice Age, and were responsible for many of the features to be found in the mountainous regions of these islands. Secondly, the raised beaches and river terraces will be examined and an attempt made to correlate them with those of northwest Europe. Members of the party are: L. H. McCabe, leader and geomorphologist; M. B. Adams, R.E., surveyor; W. G. V. Balchin, geomorphologist; W. B. Harland, geologist; P. M. M. Pritchard, in charge of medical stores; N. Pye, surveyor.

DISCUSSION

ONE-MAN CITATION OF AUTHORITIES FOR BOTANICAL NAMES

Botanists should consider the advantages of the one-man citation of authorities for scientific names. As matters now stand it is difficult, when writing of plants, to do so without constantly turning to manuals for a verification of every one of those complex citations such as: *Luzula campestris* (Linnaeus) De Candolle, var. *multiflora* (Ehrhart) Čelak; or *Croton texensis* (Klotzsch) Mueller of Argau; or *Lappula Redowskii* (Hornemann) Greene, var. *occidentalis* (Watson) Rydberg. But it is a simple affair to recall *Quercus phellos* Linnaeus, *Quercus macrocarpa* Michaux, *Carpinus caroliniana* Walter, *Salix humilis* Marshall.

The zoologists have long reduced the authority citation to one man. Alas, it seems to me they have chosen in every case the wrong man! They have picked out *the original authority, who first described the species,* on the basis that he deserves the credit. But take the green heron, often given as *Butorides virescens* (Linnaeus). Suppose that we wish to return to the original description of this bird. Will we in all Linnaeus' writings find a creature under the name *Butorides virescens?* We will not, for the simple reason that Linnaeus never made such a combination. The green heron is almost hopelessly buried from us in his voluminous writings under the name *Ardea virescens,* while the author of the combination *Butorides virescens* is Bonaparte, and if zoologists would cite it that way we would have some idea how to trace our way back to an original description. Bonaparte will, almost of necessity, tell us whence he derived the name *virescens* that he has transferred to a new genus.

The botanical one-man citation, as it was formerly much used in this country and abroad, was the opposite of the zoologists' present system. It cites the man who transferred the specific name into the *correct* genus. Thus the pawpaw, now given as *Asimina triloba* (Linnaeus) Dunal, would be, under the one-man citation, simply *Asimina triloba* Dunal. This sort of citation would, in the aggregate, save hours of time for everyone who uses botanical nomenclature.

The objections to this type of citation are these:

(1) "The original author is deprived of credit." But the purpose of citing authorities is simply bibliographical. It is to distinguish John Doe's homonym from Richard Roe's. And to lead you back, *via* his name, to a printed description. The lure of giving credit is pernicious, encouraging the making of ill-founded species.

(2) "The one-man citation might encourage name-jugglers to attach their names to everything." But this is done with equal success under the two-man system. Look at the sport that Otto Kuntze and Dr. E. L. Greene had in transferring everybody's species into a very new, or a very old genus, and thus forcing you to mention them endlessly.

(3) One-man citations "conceal the history of the species." Why, except in elaborate taxonomic work, should it be revealed? Even then the one-man citation would still be enough for the titular name of the plant. The name-bringing synonym could be cited, along with all other synonyms, under the accepted name.

The double citation, in America, is a thing chiefly of the last forty years. In England and France it is still highly unpopular and often disregarded. The one-man citation was, in effect, used by De Candolle, Lamarck, the Hookers and Asa Gray, to mention but a few of the most famous names. The double citation is shallowly rooted in custom and could still be easily weeded up.

Donald Culross Peattie

TREATMENT OF BLACKTONGUE WITH COZYMASE

The report of Elvehjem, Madden, Strong and Woolley[1] that nicotinic acid will cure blacktongue of dogs has created considerable interest in the role of nicotinic acid in metabolism. Since codehydrogenase (cozymase) contains nicotinic acid, it seemed desirable to determine whether this substance, given in doses below the effective level of nicotinic acid, would have a curative effect on blacktongue.

Professor O. Warburg very kindly furnished us with 5 mg of diphosphopyridine nucleotide and 5 mg of triphosphopyridine nucleotide. Three milligrams of each preparation were given intramuscularly to a dog in an acute attack of blacktongue. No therapeutic effect was seen.

We then prepared approximately 200 mg of partially purified cozymase (diphosphopyridine nucleotide) according to the method of Meyerhof and Ohlmeyer.[2] A similar preparation is reported by them to be approximately 80 per cent. pure. The activity of our preparation and that of Warburg's triphosphopyridine nucleotide was determined by the growth-stimulating effect on *Haemophilus parainfluenzae,* according to the method of Lwoff and Lwoff.[3]

The order of activity of our preparation approximated that of Professor Warburg's material (in dilution of $1:2 \times 10^6$ in our hands).

Two dogs in an acute attack of blacktongue were each given a total of 50 mg of this material intravenously without any observable therapeutic effect.

---

[1] C. A. Elvehjem, R. J. Madden, F. M. Strong and D. W. Woolley, *Jour. Amer. Chem. Soc.*, 59: 1767, 1937.

[2] O. Meyerhof and P. Ohlmeyer, *Biochem. Zeits.*, 290: 334, 1937.

[3] Andre Lwoff and Marguerite Lwoff, *Proc. Roy. Soc.* B, 122: 352, 1937.

Conclusion

No therapeutic effect on blacktongue was observed from the intravenous administration of 50 mg of an impure preparation of diphosphopyridine nucleotide.

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H. F. Fraser
W. H. Sebrell
Margaret Pittman
National Institute of Health,
U. S. Public Health Service

THE NATURE OF THE MUCO-POLYSACCHARIDE OF SYNOVIAL FLUID[1]

The viscous fluid bathing the joint surfaces and thought to be produced by cells of the synovial epithelium yields on acidification a stringy precipitate which has been called the synovial mucin. By a modification of the methods described for the isolation of chondroitinsulfuric acid from cartilage[2] we have succeeded in obtaining from bovine synovial fluid a sulfur- and phosphorus-free polysaccharide acid of high molecular weight, containing per equivalent weight one equivalent each of nitrogen, hexosamine, acetyl and hexuronic acid. It appears to be identical with hyaluronic acid, the polysaccharide isolated from bovine vitreous humor,[3] from human umbilical cord[4] and from hemolytic streptococcus.[5] This conclusion is based on the similar composition and rotation and on the hydrolysis at a similar rate by the "autolytic enzyme" of pneumococcus.[6] We have obtained about 200 to 250 mg of the acid per liter of cattle synovial fluid, and 225 mg per liter from 160 cc of a human knee exudate. Like other acid polysaccharides the carbohydrate in synovial fluid occurs as a salt and not bound to protein. Solutions of the isolated polysaccharide are extremely viscous and the substance apparently is responsible for most of the viscosity of the native fluid even though present in a low concentration. It is of interest that the same polysaccharide is elaborated by hemolytic streptococci (Group A, Lancefield), by the ciliary epithelium and by the synovial tissue. It may be of further interest that hemolytic streptococcal infection is frequently incriminated in inflammatory conditions affecting those tissues in which the polysaccharide is found.

Karl Meyer
Elizabeth M. Smyth
Martin H. Dawson

THE LAND-SNAIL AN INTERMEDIATE HOST OF THE CECAE FLUKE OF POULTRY

The life history of *Postharmostomum gallinum* has heretofore been unreported. Experiments conducted during the past year have revealed that land snails, *Eulota similaris*, are the common carriers of this fluke under natural conditions. Snails collected in fluke-endemic poultry farms near Honolulu have been found heavily infected with larval flukes (adolescercariae); the largest of these flukes measured 0.87 mm long and 0.39 mm wide, and possessed well-developed suckers and ceca closely resembling those of the adult fluke. When three two-month-old laboratory-raised cockerels were fed such infected snails and killed one month later, adult *P. gallinum* flukes 5 to 6 mm long by 2 mm wide were recovered from the ceca. Control birds under the same laboratory conditions, but not fed infected snails remained free from all helminths. The results reported here are of importance from the control standpoint, in view of the common occurrence of these flukes in poultry in Hawaii.

Joseph E. Alicata
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SCIENTIFIC BOOKS

LOW TEMPERATURE PHYSICS

Low Temperature Physics. By M. and B. Ruhemann. Cambridge: at the University Press; New York: The Macmillan Company, 1937. ix + 313 pp. Price, $5.00.

Kammerlingh Onnes, the acknowledged father of low temperature research, frequently compared his investigations to a polar expedition. Lengthy and careful preparation was a preliminary. The actual work had to be carried on by a large group highly organized, a squad of technicians to operate the hydrogen liquefier, another for the helium liquefier, a group of observers at galvanometers, others at manometers and so on. Then, when the low temperature region was entered, it was a kind of "never-never" land in which the ordinary rules of behavior were suspended. Electrical and thermal conductivity took on outlandish values, radiation disappeared, and vapor pressures vanished.

It is this character found in all low-temperature research which gives the field a kind of unity and which fully justifies this interesting monograph by one of the leading "explorers" of our day. Because of the variety of observations which are now carried on below one hundred degrees absolute it has been impossible in a small book to do more than pick out and describe briefly a few of the more striking examples in each line of work. As stated in the preface: "Though this book may be of some use to the specialist, we have had in mind as prospective readers rather physicists specializing in other fields . . ." For this purpose the material is admirably selected.

---

[1] From the Department of Ophthalmology of the College of Physicians and Surgeons, Columbia University, and the Institute of Ophthalmology of the Presbyterian Hospital, and from the Edward Daniels Faulkner Arthritis Clinic of the Presbyterian Hospital, New York.

[2] K. Meyer and E. M. Smyth, *Jour. Biol. Chem.*, 119: 507, 1937.

[3] Recently the identical polysaccharide has also been isolated from pig vitreous humor.

[4] K. Meyer and J. W. Palmer, *Jour. Biol. Chem.*, 114: 689, 1936.

[5] F. E. Kendall, M. Heidelberger and M. H. Dawson, *Jour. Biol. Chem.*, 118: 61, 1937.

[6] K. Meyer, R. Dubos and E. M. Smyth, *Jour. Biol. Chem.*, 118: 71, 1937.

The book is divided into four parts, the first and longest being entitled "Phase Equilibrium" and dealing with the history and recent developments in liquefaction, measurements of low temperatures and phase diagram studies. The early work of Pictet, Dewar and Linde is graphically described with many quotations from original letters and papers. Unfortunately, the date of Kammerlingh Onnes' death is given as 1924 instead of 1926. The second part deals with the "Solid State," x-ray methods, thermal energy, the "Third Law of Thermodynamics." The third part covers "Orbit and Spin," the production of temperatures of the order of one hundredth of a degree by the Giauque method. The fourth part, "The 'Free' Electron," deals with superconductivity. There is an excellent bibliography covering the literature up to May, 1937.

The work described undoubtedly constitutes one of the most exciting chapters in modern science and the authors have presented the material in a vigorous and interesting manner. As a reference book, it could have been made much more valuable by the more careful labelling of equations and figures with units.

Donald H. Andrews

The Johns Hopkins University

SOUND WAVES, THEIR SHAPE AND SPEED

Sound Waves, Their Shape and Speed. By Dayton C. Miller. The Macmillan Company. 1937.

Professor Miller in this small book gives us an account of certain work which he has done some time ago and never before fully reported. The first research here treated included the development of his phonodeik, the instrument with which he obtained by purely mechanical means most satisfactory photographic records of the form of sound waves. The second major item deals with a series of experiments in which apparatus somewhat like the phonodeik was used to measure the velocity of sound from high-power guns, the form of their sound-waves, and the pressures produced by them at various distances. In addition, there is an important chapter on spark-photography of sound waves, and of bullets in flight, and one on the velocity of sound in air.

The account which Professor Miller gives of these studies is a model of clarity, and the research itself is a model of thoroughness and scientific accuracy. Every student of physics should read this book for the interest in the subject-matter and for the example it sets in proper research methods and in the presentation of results.

F. A. Saunders

Harvard University

SPECIAL ARTICLES

EXPERIMENTAL INTERSEXUALITY: THE PRODUCTION OF FEMINIZED MALE RATS BY ANTENATAL TREATMENT WITH ESTROGENS[1]

The production of masculinized female rats by antenatal administration of androgens has been reported.[2,3,4] Until very recently attempts to produce feminized male rats by the antenatal administration of estrogenic substances (estrone, estradiol and estradiol benzoate) have been unsuccessful. Dosages that would conceivably cause feminization of the genetic male fetuses, when administered to pregnant rats, caused resorptions of the pregnancies. However, one full-term litter which showed slight changes in sexual development was obtained. The mother of this litter had been given 0.8 mg estradiol in divided doses from the thirteenth day to the twentieth day of pregnancy. Two new-born males of this litter were serially sectioned, and it was noted that there had been definite inhibition of development of the prostatic diverticula and of the seminal vesicles.

A generous amount of estradiol dipropionate has been made available to us through the courtesy of Dr. Ernst Oppenheimer, of Ciba Pharmaceutical Products, Inc. This compound is very slowly absorbed and consequently has a very prolonged estrogenic effect. Thirty-two pregnant rats have been injected with this compound, usually in single doses of 0.375 mg to 4.0 mg on the thirteenth, fourteenth or fifteenth day of pregnancy. Nineteen of these animals have carried to term and 24 males have been obtained from these litters. Fourteen of these males, the mothers of which had received 2.0 to 4.0 mg of estradiol dipropionate, had grossly visible nipples at birth and were hypospadiac. Normally nipples are not present in the males rats of our colony. Normal new-born males have a completely formed penile urethra. In eight animals (all from different litters) the testes were in abnormally high position and in three, the testes were in the typically female position, at the base of the kidney.

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[1] This work has been supported in part by a grant from the Josiah Macy, Jr., Foundation.

[2] R. R. Greene and A. C. Ivy, Science, 86: 200, 1937.

[3] R. R. Greene, M. W. Burrill and A. C. Ivy, *Proc. Soc. Exp. Biol. and Med.*, 38: 1, 1938.

[4] R. R. Greene, M. W. Burrill and A. C. Ivy, Science, 87: 396, 1938.

Eight of these new-born males (each from a different litter) have been serially sectioned to date. One animal (0.5 mg estradiol dipropionate) showed marked inhibition of the ventral prostatic diverticula and a moderate inhibition of the posterior diverticula. In another animal (1.0 mg estradiol dipropionate) the ventral prostatic diverticula were absent and the posterior diverticula were scanty. In six animals (2.0 to 4.0 mg estradiol dipropionate) the prostatic diverticula were entirely absent. Furthermore, in each of these six animals there was a vagina which was comparable in development to that found in the normal new-born female. In four of these six cases marked inhibition of the right vas deferens was found. The lumen of the vas was absent throughout most of its length and, in some regions, even the epithelial cells had apparently completely degenerated. In all animals the seminal vesicles exhibited some inhibition or departure from normal development in that the cranial flexure which is typical of this organ at this stage was absent. The epididymides also showed evidence of inhibition inasmuch as the convolutions of the ducts were less numerous than in the normal males.

On the basis of the few animals observed, it seems that the amount of development of female structures (vagina and nipples) and inhibition of male structures has a fairly definite relationship to the dosage given.

The females in these litters have not been examined microscopically to date. However, some changes from the normal have been grossly visible. Large nipples have been present in the new born. Normally nipples do not appear in the female rats of our colony until the fifth to tenth day. Usually in the same litter the females had more and better developed nipples than the males. The uteri were grossly enlarged and apparently distended. The development of the ovarian capsule had been inhibited; with the higher dosages no ovarian capsule was present.

CONCLUSIONS

The administration of large amounts of an estrogenic substance to the pregnant rat has so modified sexual development of genetic male fetuses that feminized males or intersexed animals have resulted.

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XANTHINE OXIDASE: AN ALLOXAZINE PROTEID

A XANTHINE oxidase preparation has been obtained that is 500 times more active per unit dry weight than the whole milk used as a source. The activity has been determined by measuring manometrically the oxygen consumption, usually with hypoxanthine as the substrate, though xanthine and aldehydes may also be employed. Solutions of this enzyme preparation containing 6 mg/cc have a strong golden brown color and possess an absorption spectrum with a band in the visible lying between λ400–500 mμ. This band disappears if hypoxanthine is added to a solution from which air is excluded. The original color can then be rapidly restored by the admission of air. If the spectrum of the reduced enzyme preparation is subtracted from that of the oxidized form, a spectrum is obtained which is similar to that of the "gelbe ferment" in having two bands centered at λ370 mμ and λ465 mμ, respectively. The prosthetic group may be split off from the protein by the addition of acid or alcohol. Such solutions are pure yellow in color, fluoresce strongly and possess the characteristic absorption spectrum of a flavin with two bands centered at λ450 mμ and λ375 mμ. Definite proof of the flavin nature of the prosthetic group is furnished by the fact that it can be quantitatively converted by the method of Warburg and Christian[1] into a lumiflavin, the absorption spectrum of which is identical with that given by these workers. Complete separation of the flavin part from the protein without destruction of the latter has not yet been accomplished. It is, however, possible to obtain a partial separation. The protein part so obtained shows a 3-4 fold increase in activity on the addition of the flavin component. The flavin alone is inactive. If the flavin containing co-ferment of the amino acid oxidase recently isolated by Warburg and Christian[2] or lactoflavin phosphate is substituted no increase in activity is obtained. It therefore appears that xanthine oxidase is to be classified as an alloxazine proteid whose active group is of a different composition from those flavins hitherto known. Further details will be published elsewhere.

I am indebted to Professor Otto Warburg for his valuable advice and generous provision of laboratory facilities during this investigation.

ERIC G. BALL,
Fellow of the John Simon Guggenheim Memorial Foundation

KAISER WILHELM-INSTITUT FÜR
ZELLPHYSIOLOGIE,
BERLIN-DAHLEM

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[1] O. Warburg and W. Christian, *Biochem. Zeits.*, 266: 377, 1933.

[2] O. Warburg and W. Christian, *Biochem. Zeits.*, 296: 294, 1938.

COLLETOTRICHUM CIRCINANS AS A SEMI-QUANTITATIVE TEST UNIT FOR THE GROWTH SUBSTANCE PRODUCED BY RHIZOPUS SUINUS

WHILE testing the filtrate of *Rhizopus suinus* Nielson on the growth of various species of fungi, it was noted that *Colletotrichum circinans* (Berk.) Vogl. gave consistent increments in yield over a limited range of concentrations. This characteristic response of the organism mentioned suggested its use as a means of measuring the relative growth substance concentration. Subsequent work has shown that this fungus will serve not only as a qualitative but also as a semi-quantitative test unit for the growth accelerator concerned. Nielson and Hartelius (1932) showed that the extract from *Rhizopus* exerted an influence on the dry weight yield of *Aspergillus niger* Van Tiegh., but gave negative results when tested with the oat coleoptile. Although its chemical structure is still unknown, it has properties which render it insoluble in common organic solvents, and it is stable to both oxidation and heat. Their results, which were duplicated in this laboratory, prove that it is not a nutrient and that it is not identical with heteroauxin.

In order to measure this substance, investigators have relied, heretofore, upon *Aspergillus niger*. The *Aspergillus* technique does present certain distinctive features, *viz.*, (1) the time involved is short and a large number of runs can be completed in a given time; (2) the effect is an initial one, and (3) the comparisons are based on dry weight yields, and thus an unevenness of growth does *not* invalidate the results. The *Colletotrichum* technique, on the other hand, has several definite advantages, *viz.*, (1) the change in yield is greater per increment of growth substance added; (2) the results of replicates show a lesser variation; (3) temperature fluctuations over a few degrees (standard 25° C.) are of little significance; and (4) successive daily changes in the growth rate for a given culture can be recorded and studied.

The method is essentially as follows: The *Rhizopus* mat is filtered from its liquid substrate and the resultant filtrate is concentrated, by partial evaporation, to one third or less of the original volume. This constitutes the stock solution. A 1 cc aliquot of the stock solution or a dilution thereof is placed in the bottom of a sterile 100 mm petri dish. To this is added 30 cc of a nutrient-agar solution containing M/400 $MgSO_4$, M/220 KH_2PO_4, M/16 NH_4NO_3, M/5.5 sucrose, 1.7 per cent. agar and a trace of ammonium tartrate.

Plates made in this manner are cooled and are inoculated with circular blocks (1 mm diam.) of non-fruiting hyphae of *Colletotrichum circinans* growing on an agar substrate. Diameter measurements are made every few days with the aid of a mimeoscope. These figures are compared directly or comparisons are made of the slopes of the plotted curves. Diameter comparisons, and not area measurements, are used since they more nearly approach the true values. This point will be presented in a subsequent paper.

The example below, which has been repeated several times, will serve to illustrate this technique. The actual diameters are measured every two or three days. The values for the third day are used as the starting point, since the transfer of the inoculum affects the initial growth, in an unpredictable manner, invalidating the use of the size of the planting as the criterion. Values for subsequent days are measured as increases over the values for the third day. These last are then corrected so that each test will have the same base line as the control.

These corrected diameters (in mm's) become:

	Days					
	3	5	7	9	12	15
Control	0	7.2	11.0	14.8	19.0	23.0
plus 1 cc	0	9.8	17.2	21.8	28.2	32.2
" 2 cc	0	11.2	18.2	24.2	32.8	38.6
" 3 cc* ...	0	10.4	18.6	26.0	35.4	44.4

* The value 3 cc refers to 1 cc of a stock solution three times as concentrated as the original filtrate.

The values for the fifteen-day period are most profitably used. When an unknown is run, it is necessary to interpolate for those which fall intermediate to the values listed above. This method, therefore, becomes of special interest for small changes in the amount of growth substance and can be used also for larger changes by concentrating or diluting the stock solution so that the test values will fall within this range.

CLAIR L. WORLEY
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BOOKS RECEIVED

CATTELL, RAYMOND B. *Crooked Personalities in Childhood and After.* Pp. xi + 215. Appleton-Century. $2.00.

International Encyclopedia of Unified Science: Vol. I, No. 1, Encyclopedia and Unified Science, OTTO NEURATH and others. Pp. viii + 75. *No. 2, Foundations of the Theory of Signs,* CHARLES W. MORRIS. Pp. vii + 59. University of Chicago Press. $1.00 each.

PARK, WILLARD Z. *Shamanism in Western North America; A Study in Cultural Relations.* Pp. viii + 166. Northwestern University. $2.25.

Recueil des Travaux Chimiques des Pays-Bas, Tome 57, No. 6, June, 1938. LIVRE JUBILAIRE J. BÖESEKEN. Pp. 344. Illustrated. D. B. Centen's Uitgevers-Maatsch, Amsterdam. Dutch florins 3.

University of Missouri Studies; A Quarterly of Research. Vol. XIII, No. 2, April, 1938; Distance Geometries; A Study of the Development of Abstract Metrics, LEONARD M. BLUMENTHAL. Pp. 145. The University, Columbia. $1.25.

WIEMAN, H. L. *General Zoology.* Third edition. Pp. x + 497. 271 figures. McGraw-Hill. $3.50.

WILLIAMS, ROGER J. *A Textbook of Biochemistry.* Pp. x + 525. 17 figures. Van Nostrand. $6.00.

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CHEMISTRY AND THE FUTURE

By Professor HAROLD C. UREY

COLUMBIA UNIVERSITY

IN discussing any subject which deals with an extrapolation from the past to the future, one can not make any certain or dogmatic statements. In the physical sciences extrapolations are very likely to be incorrect even when they involve only a small percentage of the region covered by reliable data unless a very fundamental theory of the phenomena based upon broad scientific evidence exists. Such conditions do not obtain with regard to my subject, and I can not risk more than the most general predictions in regard to the future. Moreover, these general predictions must be predicated upon several alternatives which are definitely beyond the control of chemists or scientists, and which are vital to their future.

It is necessary, in the first place, to consider the objectives of two groups of people. The first of these is the scientific group, and the second is the group consisting of the community as a whole. In neither case are the objectives exactly formulated, though it seems to me that those of the scientific group are more definite than those of the community in which we work. Of course, the objectives for all chemists or all scientists are not the same, but there is a very considerable agreement between these individuals. The people of the community, on the other hand, are swayed by so many emotions that these appear to be the most unpredictable quantity in the entire problem.

Scientific men are those who are posing particular questions to nature and its laws as they operate about us. In doing so they arrange most carefully devised experiments to test whether the ideas which they have in regard to the operation of natural law are in fact in accordance with these laws. If their postulates are not correct, the answer which they receive is an emphatic negative, and nature resists all efforts to impose erroneous ideas upon her. But if their postulates are in accordance with what we call natural law, nature unlocks her secrets with an amazing ease. When this occurs there is a communion between scientists and the eternal laws governing the behavior of this universe that is very intimate indeed. This communion represents the highest reward which a scientist receives for his services, and it is this that furnishes the major driving force for all his activities.[1]

A secondary objective of his activities is also important. Experience has shown that this understanding of nature's laws makes it possible for man to improve his physical well-being by adapting them to his own purposes. No matter where we work in our university or industrial laboratories, whether upon purely intellectual pursuits in connection with scientific things or upon the immediate use of these laws of nature, we all have in mind this second objective. We desire that the things that we do shall at some time and somewhere be of use to our fellow men in their physical and intellectual pursuits.

On the other hand, the divergence of the objectives of the people of the community, as shown by current activities, is truly amazing. There are extensive organizations of men whose activities if successful would make man supremely wealthy, would bring him dire poverty, would make him well informed even if not more intelligent, reduce him to the ignorance of dumb beasts, would destroy not only his home and useful material things, but would waste and destroy the sources of this wealth. As one watches to-day and attempts to see what chemistry or its sister sciences will do in the future, one can only feel that his own and all other prophecies are mere guesses without even an estimate of the probable errors. I can not say what it is that man really desires. In fact, it is not the desires of any localized group, but very largely the desires of men in the entire world that are important in this connection, for those in any one part of it may be forced to do things which they do not desire, because of the activities of others. I can only contribute to this discussion by pointing out some things which can be aided by chemistry if certain objectives are desired.

In the first place, chemistry can and perhaps will destroy our European civilization. In the efficient destructive machines which are in use to-day the most important agent is a chemical substance, an explosive, an incendiary mixture or a poison gas. All the other scientific contributions to these machines are to make this distinctly chemical contribution effective. The last great war demonstrated that these destructive methods can destroy the wealth of countries to such an extent that many years are required to even partially recuperate, and as a secondary result they can damage governmental régimes beyond repair and can make a world less safe for democracy or anything else. It appears to-day that even greater effects will result from another such war, and I do not believe that it is too much to say that a complete destruction of our civilization may result from such a war. The most crucial requirements for such conflict are chemical in nature. The secondary materials required for the support of armies and their movements are also to an important extent chemical in nature and greatly dependent on chemical industries. Liquid fuel is vital to the transportation of armies at the present time, and in addition chemistry contributes to nearly all the materials used in a modern war, as well as in peace. If the people of the world desire to make war chemistry will aid them. It will destroy people, their material possessions, and will dissipate and destroy the resources of the earth.

A very different future of chemistry can be painted if people so desire. If chemistry is permitted to devote its energies to peaceful pursuits, an abundance of goods valuable to man can be produced, and in addition it can contribute, together with its sister sciences, to man's knowledge of the universe and his place in it. It will help to free him from superstition and error, and will bring him intellectual pleasure.

In the past many of our sister sciences have contributed notably to the broadening of man's intellectual horizon. Astronomy gave him a proper perspective of his own importance and his own position in this universe. His earth is not the center of the solar system, nor is his solar system the center of this galaxy. At the same time that he was robbed of his central position in the physical universe what a grandeur has been spread before him as our knowledge of astronomy grows! Biology has robbed him of his miraculous creation by one or another anthropomorphic god, and has placed him in the lowly position of one of the animals, that one, in fact, who in this particular geological age dominates the earth, but at the same time the grandeur of an organic evolution with time has been spread before him. Geology has shown him the long length of time that man and his lowly ancestors have existed on this planet, and in fact that life on this planet has been nearly coexistent with the planet. Chemistry up to the present time can claim no such important contributions to man's understanding about himself. People have had no previous conceptions of the structure of matter either erroneous or otherwise, and thus the atomic theory has not driven clouds of superstition away. No traditions or prejudices have prevented us from manufacturing soap and sulfuric acid, or even synthetizing such things as sex hormones, and thus chemistry has operated during the past years with great freedom and with little opposition from our fellow men. Chemistry is, however, perhaps contributing to the present situation which has stimulated conferences of this sort. During the last century, and particularly the years of the twentieth century, chemistry and the other sciences have greatly increased our productive capacity. This productive capacity has been increased beyond anything which the world has previously seen, and promises to greatly increase it in the future. At the present time this development is probably causing the enormous social change which we who are here can not see in the proper perspective because we are a part of the phenomena. It seems to me that there is little doubt but what much of the unrest of the civilized world for the past twenty-five years, resulting in revolutions, new systems of governments and world-wide depression, is all rather closely related to this productive capacity largely brought about by science. This has been recognized by others and the suggestion has been made that the proper cure of these things is to artificially decrease our ability to produce. This is a cowardly point of view. In spite of all the many perturbing events which have arisen, it seems to me, as a result of this important change, we should look forward to the future with the greatest hope. If we act with courage our descendants will live in an abundance of necessities and luxuries the like of which we can not imagine. If we are not courageous, they may live with less than we have at present.

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[1] R. S. Mulliken (Science, 86: 65–68, 1937), has given an excellent discussion on the methods and objectives of scientists.

Chemistry is a study of the substances which we find about us. From the materialistic side chemistry can supply materials in abundance and in great variety. Most of the materials used in all construction to-day, with the exception of wood, are the product of chemistry, and wood as it is used is improved and preserved in many cases by the use of chemicals. Metallurgy is essentially a branch of chemistry, dealing with the preparation and the utilization of metals. Just how much of such materials are supplied in the future is not a matter of chemistry, but one of social organization. We have laboratories and men to produce all that can be accepted by industry at the present time, and we can train the necessary men and build and equip all laboratories needed in the future. The cost of chemical research, and, in fact, of all research, is but a very small fraction of the production costs, and the result pays most handsome dividends in new materials and new processes.

Without in any way wishing to place blame, we may note that since the world war no country has arranged its internal affairs in such a way that anything approaching the maximum production of material goods for peaceful purposes has been accomplished. Among the large countries Russia only has stated that her objective was the production of goods for use.. Due to a mistake in political philosophy, inadequate numbers of properly trained men and the necessity of defending two borders some six thousand miles apart against threats of invasion, her achievements have not been satisfactory. England, with a correct political philosophy, with a remarkable mineral wealth and being the home country of a friendly commonwealth of nations, has not succeeded in this respect, as any one can see who travels in England and who observes the amount spent on the dole, and has sufficient imagination to think of living on its stipend. Germany, with another political philosophy, has definitely decided in favor of guns rather than butter, and in addition has a definite lack of natural resources and apparently lacks the bargaining ability to secure them. The United States and Canada have succeeded better than any other country, due undoubtedly to a correct political philosophy, adequate resources, adequately trained men and freedom from threats of invasion. We desire peace, and we have a desire for the good things which science and technology can bring. There was, however, some fatal defect which caused an increasing unemployment which led to the break in 1929, and our inability since then to get this production machinery going again. The average for the years since the world war for all the people of these two countries has not been satisfactory. Other countries could be reviewed, but the story is so similar as to be monotonous. Perhaps the Scandinavian countries have done as well as or better than any in this respect, but they are not easily compared with the larger units which I have just mentioned. Perhaps the correctness or incorrectness of the political philosophy is important, but I think that it is impossible to see clearly that such is the case from the examples that we have considered so far.

Our people wish those things which chemistry can bring to them, but for some reason our chemical plants are partly idle, our chemists unemployed, and our workmen are on some form of direct or indirect relief. This is the problem of the future of chemistry which does not yield to chemical methods of solution, and without its solution it is only possible to express hopes for the future.

Since the beginning of scientific chemistry some 150 or 200 years ago there has been an accelerated rate with which our scientific discovery and invention has taken place. At the beginning of the nineteenth century Dalton proposed the atomic theory, which has dominated all chemical theory and experiments since then. During the century, 34 chemical elements were discovered, bringing the total known elements to 81. The chemical properties, methods of preparation and analysis of the elements and their compounds were extensively studied. The system of classification of the chemical elements known as the periodic system was discovered. The extensive chemistry of the compounds of carbon and the syntheses of compounds occurring in natural products were begun and greatly advanced during the century. The fundamental laws of thermodynamics were proposed and the beginning made of their application to chemical problems. The foundations of statistical mechanics which have been used recently in the understanding of chemical problems were laid in that century. In addition to the old chemical processes, such as the limited manufacture of soda and mineral acids, this century saw the beginning of the extensive manufacture of coal-tar dyes and the use of petroleum. The growth of chemistry during the century was so great that in 1900 one might wonder what was yet to be done, and yet growth since 1900 has been so great that one naturally feels that very little was known at that time.

I wish to illustrate the growth of this science since 1900 by giving a partial list of the important discoveries made since then. I am including in this table some things which perhaps belong rather in the field of physics because they have contributed in such an outstanding way to the science of chemistry.

1899	Discovery of the quantum theory by Planck
1901	Synthesis of polypeptides—E. Fischer
1902	Hydrogenation of fats—Normann
1905–1913	Development of the Haber process
1906	Third law of thermodynamics—Nernst
1872–1908	Bakelite—first of important plastics
1911	Nuclear atom—Rutherford
1911	Discovery of isotopes—Fajans and Soddy
1912	Diffraction of x-rays and crystal structure—v. Laue and Bragg
1912	Preparation of pure anthocyanines—Willstätter
1913	Quantum theory of the atom—Bohr
1916–1938	Structure of monomolecular films—Langmuir
1919	First transmutation—Rutherford
1920–1930	Rapid development of rayon manufacture
1920–1938	Chemistry of sterols, bile acids and sex hormones—Windaus, Ruzicka, Karrer and others
1921	Discovery of insulin—Banting
1923	Debye-Hückel theory of electrolytes
1923	Ultracentrifuge and molecular weights of biochemical substances—Svedberg
1926	Attainment of very low temperatures by magnetic methods—Giauque and Debye
1926	The exact quantum theory—de Broglie, Heisenberg, Schrödinger, Dirac
1926	Constitution and synthesis of thyroxin—Harington
1926	Isolation of vitamin B_1 in crystalline form—Jensen and Donath
1926	Preparation of vitamin D by irradiation of ergosterol—Windaus and Pohl, Rosenheim and Hess
1927–1938	Theory of valence—Heitler, London, Slater, Pauling, Mulliken
1927	Isolation of vitamin C—Szent-Györgyi
1927	Application of quantum theory to kinetics of reactions—Polanyi, Eyring
1929	Synthesis of porphyrins—Hans Fischer
1930–1938	Crystallization of enzymes—Sumner, Northrup
1931	Deuterium—Urey
1931	Synthetic rubber
1931	Constitution of carotinoids and vitamin A—Karrer
1932	Discovery of Flavin enzymes—Warburg
1933	The constitution of coferments
1934	Artificial radioactivity—F. and I. Joliot-Curie
1935	Isolation of the tobacco leaf mosaic virus protein—Stanley

There are three main developments which are worthy of discussion in regard to the development of the last thirty-eight years. These are:

(1) The development of our understanding of the structure of atoms and molecules, and the application of this knowledge to an understanding of chemical reactions.

(2) The development of the field of biochemistry, which has concerned itself with the isolation and synthesis of compounds occurring in living organisms and with their physiological effects and applications to medicine and hygiene, and

(3) The development of one of the largest modern industries, namely the chemical industry with its many ramifications.

Other important developments represented in this list not included in the three items that I have just mentioned are the Debye-Hückel theory of electrolytes, the discovery of monolayers by Langmuir and others, and the discovery of artificial radioactivity and its important effect upon chemical research.

In the very closing years of the nineteenth century Planck announced his first postulates of the quantum theory, and this theory has dominated the developments of physical science during this century in much the same way that Dalton's atomic theory dominated the chemistry of the nineteenth century. Parallel with this development and within a few years of its first proposal, radioactivity was discovered, which led to an understanding of the structure of the atom. Rutherford recognized the essential character of the structure of atoms as the result of the use of the projectiles spontaneously emitted from radioactive substances, The study of radioactive substances led to the discovery of isotopes. X-rays, discovered within a year or so of the discovery of radioactivity, have unlocked the structure of crystals and have given us the means of measuring the distances between atoms in solids and in liquids. Bohr's theory of the atom combined Rutherford's work on the nuclear atom with Planck's quantum theory and gave us our first explanation of the thousands of wave-lengths of light emitted by atoms, and finally led to the exact statement of the quantum theory by de Broglie, Heisenberg, Schrödinger and Dirac, and from this follows an understanding of the valence forces between atoms and compounds and the velocity of chemical reactions.

Much of the biochemical work has been concerned with an understanding of protein substances, the understanding of chlorophyl and haemoglobin, the isolation of enzymes, hormones and vitamins and their syntheses. This information is particularly useful, not quite from the standpoint of medicine exactly, but more from the standpoint of avoiding in many cases the necessity for medicine, for, after all, medicines are in many ways foreign substances to living organisms. By understanding the hormones secreted by the internal glands of animals and the vitamins which we secure from foods, man in the future can be kept well rather than cured of disease. The work which I have included in this list at this time has been done principally with the object of understanding the fundamentals of biochemistry, that is, the chemistry of living things. Their use in this way is a by-product of this activity.

I have also included in the list some of the industrial processes. The hydrogenation of fats makes it possible to secure large amounts of solid fats from such cheap substances as cotton seed oil. The Haber process for the manufacture of ammonia enabled Germany to hold out against great odds in the world war. I think there can be little doubt but what Haber was the most important single individual in Germany so far as the prosecution of her war was concerned. It is interesting indeed that he was exiled by his own country in 1933 and was welcomed by his enemy, England.

Bakelite was the first of the important synthetic plastics which is now used for so much of our electrical insulation. The success of this plastic also led to the development of many others since then. The development of the modern lacquer industry is closely related to this. So many objects to-day are protected by a thin film of what is essentially cellulose, together with pigments of all brilliant colors. The manufacture of rayon greatly increased during the decade from 1920–1930, though the essentials of the process were discovered during the nineteenth century. Its successful commercial exploitation has only been possible in recent years.

In 1931 synthetic rubber was produced. This can not be produced in competition with natural rubber, but the synthetic variety has desirable properties not possessed by natural rubber. There are so many chemical processes which have been developed during this century that it is difficult to select even a few for special mention. One might mention the recovery of bromine from sea water as carried out by the Dow Chemical Company. This bromine is mostly used in the manufacture of ethylene bromide and together with lead tetraethyl is added to our gasoline. Of course, one is immediately reminded at this point that the development of gasoline is an enormous business in itself. We must immediately think of cracking processes, hydrogenation processes, processes for the recovery of natural gas, the manufacture of lubricating oils, the hydrogenation of coal, etc. It is only necessary to mention stainless steel for one to realize the great revolution in metals that has taken place in this century, for stainless steel is only one of many varieties of alloys which have found their place in modern industry. How important the whole field of detergents is! One should not forget to mention dyes, which in dollars and cents are in a way quite unimportant but which beautify our clothes, our homes and practically all articles that we use. The cost of these brilliant colors has been reduced until the poorest of the population are arrayed in colors that only the most wealthy could have afforded even so short a time ago as one century. So many of these processes of industrial chemistry are so commonplace that we fail to recall that they have not always existed. Many of them have existed only a matter of years, and a large percentage of them only a matter of decades.

The list of the important contributions which I have presented can not be extrapolated to the future. If I could make a reasonable estimate of what the next great development would be, that would be a very important step in making the next discovery. One can not predict the discovery of the Haber process or insulin or artificial radioactivity before they occur, for the reason that these are such new and outstanding things that before their discovery no one had the slightest idea that they existed. I can only point the trend. During the last twenty years the organic chemistry of products produced by living organisms has shown a remarkable growth. Vitamins, hormones, enzymes, have been discovered and isolated. Proteins have been crystalized, and, in fact, one, the tobacco leaf mosaic, appears to be a dead protein which can cause a disease and multiply itself, thus in a way bridging the living and the inanimate. This field will certainly develop markedly in the next years. In the second place, there is a marked trend toward the understanding of the fundamentals of chemical behavior. Nernst stated the third law of thermodynamics in 1906, but to-day,

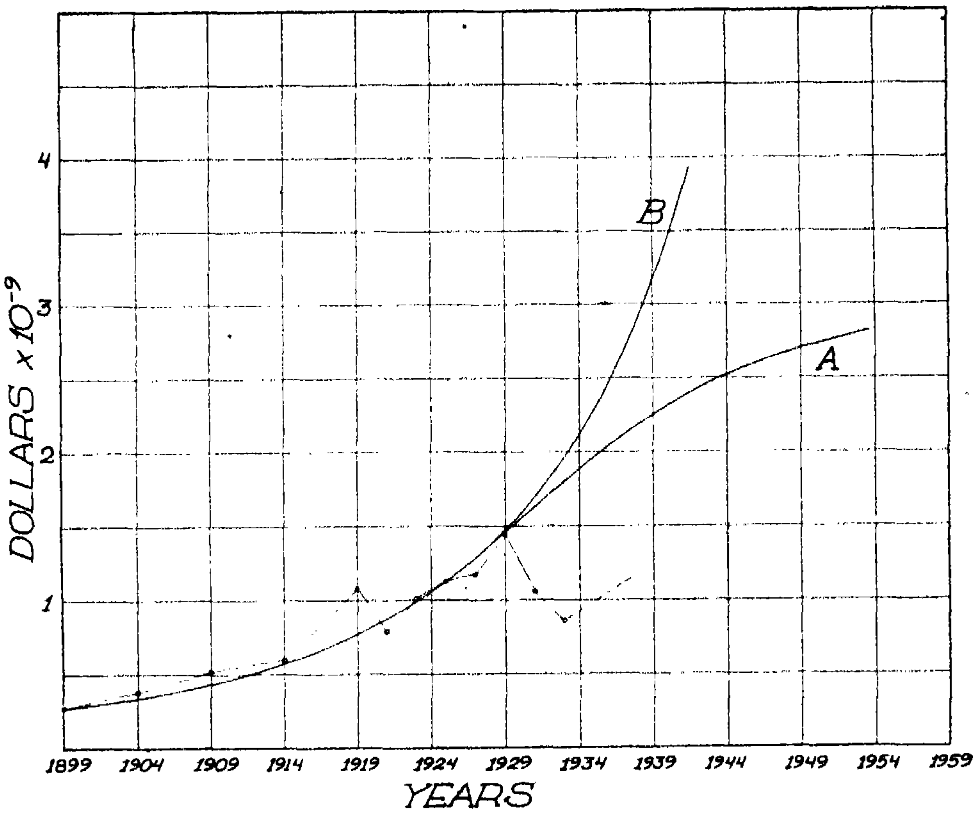

FIG. 1. Value added by chemical and allied industries to raw materials in the United States. Compiled from the Biennial Census of Manufactures, U. S. Dept. of Commerce.

together with the quantum theory, we have far more exact understanding of that law than ever before. It is being applied to chemical reactions of considerable complexity with confidence and enables us to understand far better the fundamentals of our chemistry. The new artificial radioactivity and the great activity in physics in this connection are important developments for chemical research. In the industrial field straight through the depression the number of useful products has been increased in many ways.

To show the possible future industrial development I can best use a plot showing the value of chemical products produced as a function of time in the past. The plot shown in Fig. 1 is constructed from data for the United States. This is probably one of the best countries to select for our present purposes because its industry was disturbed less by the war than most others and because there has been no change in political institutions since 1900, and, finally because it is such a large industrial country that most processes and products will be adequately represented. This shows a plot of the value of chemical products in current dollars against years. No attempt has been made to correct the dollars for the gradual depreciation of the dollar which has occurred over that time. The solid curve shows the approximate course from 1900 to 1929, and an extrapolated curve, A, beyond that time, which one might have expected the industry to follow had the 1929 catastrophe not occurred. The curve is of the usual kind characteristic of industries, grows rapidly for a while and then gradually flattens out. Further growth can not be expected unless some very marked rejuvenation occurs. The figure makes evident the fact that from 1929 to the present the production did not increase as would be expected from this curve. I leave the question of the 1929 catastrophe to economists, except for the suggestion that chemical industry and its masters, together with other industries and their masters, may not have realized the inflection point in the curve and may have stubbornly tried to make production follow the curve, B, as shown in the figure. This break in the curve in 1929 shows again how dependent the future of chemistry is on factors beyond the control of chemists. Perhaps my analysis of this problem as shown by this curve is not correct, but I do believe that the method of approach is valuable. People working with the social sciences are apt to make the postulate that there are no laws of nature underlying these economic problems and that the only important factor is man's wishes and desires. I believe that man's will in regard to these things is one factor in the problem, but that *it is not by any means all of it.* We can solve our economic problems of this kind when we approach them with the same point of view as that with which physical and biological science approach their problems. There are underlying natural laws behind the phenomena; with these laws we get the maximum good out of our efforts. If we attempt to superimpose false points of view on these natural phenomena, nature resists and our efforts bring us only the greatly decreased returns which the experimental data of this curve illustrate.

Because of the difficulties evident in this curve, as well as those that I have emphasized before in regard to the unpredictable desires of man, I can only express some hopes for the future for the industrial application of my science. I hope that in the near future the chemical production will fall on the curve, A, of Fig. 1, and that this will represent products designed for peace and not for war. It would appear that the future is able to bring better clothes for people from better cotton, silk, wool or linen or fibers better than these. These will be far more beautifully dyed than they are at the present time, and they will probably be produced with less effort than they have been in the past. The food of man will be produced in greater variety than at present. Fertilizers will make the arable areas of the earth produce a great abundance for the present populations of the earth and for even much greatly increased populations than now exist. The study of vitamins will mean that the foods will be better, more wholesome than they are at present. The dwellings of man in the future will be made of materials as yet unknown. They will be more durable, more beautiful and more easily constructed.

In addition to necessities, many luxuries will be supplied. Even if petroleum is exhausted liquid fuels will be made from materials grown on our farms. The automobile will continue with us and plane travel will still be possible so far as its fuel and lubrication is concerned. In addition to the preventive medicine which I have mentioned, in which we see to it that the proper vitamins, hormones and other necessary substances are supplied, internal medicines have been developed in the last few years which are very effective against many diseases. This development will certainly continue in the future. Since the beginning of the century many diseases have almost disappeared from civilized countries. Typhoid, for example, has largely been eliminated by adding small amounts of chlorine to drinking water. Chemistry will produce the anesthetics for surgery in the future, and disinfectants, as it has produced them in the past.

Finally, the greatly increased productive capacity which results from the use of chemistry and the other sciences must be expected to profoundly modify our social and economic institutions. This should be regarded as one of the great contributions which these things will bring to man.

My remarks at this point are not particularly original with me, nor can I prove them with the exact marshalling of data characteristic of my science. I think they are worth presenting, nevertheless. Sometimes it happens that the details of a complex set of phenomena can not be followed, but that general statements can be made about them without a knowledge of the details. The weather is a much-discussed subject, just as economics is. While we can not say precisely why the weather was hot and sultry last week, and it is cool and clear this week, we know that the general temperature is determined by the distance of the earth from the sun. Though spring may be early or late without any evident reason, we know that the changing seasons are caused by the inclinations of the earth's axis to the plane of the earth's orbit.

During the past century or so a science has developed which never existed before. Its application to industry by the various branches of engineering has proved most effective for the production of goods. These methods of production have the characteristic that they may be used to make goods cheaply in abundance but also to make them cheaply only if they are made in great quantities. The invention of limited liability corporations has proved to be the type of business organization necessary to carry out this production with the use of scientific methods. These things, together with an inadequate method for distributing the goods produced, are to my mind the underlying cause of most of the serious difficulties of this century. Probably the business rivalries which led to the world war, communism in Russia, the invasion of Manchuria and China and of Ethiopia and world-wide depression have all resulted from the great production of goods by scientific methods, together with archaic methods of distribution. If goods are to be produced in large quantities, they must be consumed in large quantities. Whatever that distributive system will be, it must distribute an abundance to many people and not to the privileged few only. If this is not done, we must abandon these mass production methods. I am optimistic enough to believe that we will accomplish this and that chemistry and her sister sciences will bring an abundant physical and intellectual wealth to our posterity; it will decrease labor and bring leisure, beauty and health. We solicit the help of the community to the end that we shall not always have the poor with us.

SCIENTIFIC EVENTS

APPROPRIATIONS OF THE BRITISH COLONIAL DEVELOPMENT FUND

THE British Colonial Development Advisory Committee, according to the London *Times*, has recommended appropriations from the funds at its disposal of £781,698. Plans for which assistance is recommended include the development and conservation of the water and forest resources of Tanganyika; the further development of water supplies in the Bechuanaland Protectorate and Swaziland; and the construction of a water supply system in Malta designed to increase the irrigated area by about 45 per cent. Anti-soil erosion measures bulk largely, particularly in proposals for reclamation and land drainage in the Machakos district in Kenya.

The *Times* states that the committee regards the tsetse fly problem as a matter of supreme importance to the British Empire. Two thirds of the total area of Tanganyika Territory are still infested with the fly, and the remaining third is threatened with rapid infestation. Huge areas in other African dependencies are similarly infested, the result being that pressure of human beings and stock on the fly-free areas constantly increases and brings with it dangers of over-grazing and consequent soil erosion. The Tsetse Research Department in Tanganyika is the central organization, and the work carried out there benefits all African territories affected by the fly. The committee has recommended a free grant to this organization of £207,974, spread over the next seven years.

Other grants are made for the development of peasant agriculture in the Leeward Islands; the recruitment of probationers for the Colonial Forest Service; and the improvement of transport and communications in various West Indian islands.

CONTROL OF EROSION IN NORTH CAROLINA

AN official statement given out by the Department of the Interior reports that out of the North Carolina Beach Erosion Control Project, now well under way with Emergency Relief Appropriation funds, an unusual and valuable possibility is being developed by the National Park Service. This is expected to have far-reaching effect in protecting the Atlantic Coast in the Cape Hatteras area from further depredations through storms.

The area embraced in the project is that section of the sea-coast lying south of the Virginia-North Carolina line and extending to Coracoke Inlet, comprising some 175 miles of ocean front. It entails the creation of protective foredunes and dune ranges over approximately 70 per cent. of the area. This will be followed by sand fixation through protective planting and reforestation, to correct the devastation that has been in progress for more than a century. The entire project is under the control of the National Park Service.

The area consists chiefly of a barrier spit between sound and ocean varying from several miles to a few hundred feet. It has been provided by Congress that ultimately this coast may be set aside as a national seashore recreational area, the first of its kind on the Atlantic coast. For this purpose the Cape Hatteras section was selected as one of the most promising for development, because of its nearly primitive character and its historic value. Before the national seashore can be established, however, the enabling legislation provides that the lands involved in the project must be donated to the Federal Government.

From the new nursery of the Park Service already have come thousands of seedlings to plant many acres on the beach. Since the spring planting additional thousands of seeds have been planted in the nursery and new beds are now being prepared for next fall. If the nursery is successful in providing seedlings for each planting, a considerable amount of money will be saved on the project. It is believed that seeds collected locally probably have a better chance to survive the exposure to which they are subjected than seeds purchased from other sources.

INTERNATIONAL TECHNICAL COMMISSION OF PHARMACOPOEIAL EXPERTS

AT the recent session of the Health Organization of the League of Nations a commission was appointed to carry on the work of the Brussels conference for the establishment of standards for potent medicines. The committee consists of: Dr. C. H. Hampshire, chairman, London; Professor H. Baggesgaard, Copenhagen; Professor V. E. Zunz, Brussels; Professor M. Tiffeneau, Paris; Professor R. Eder, Zurich; Professor L. van Itallie, Leyden; Professor E. Fullerton Cook, Philadelphia; a member of the Union of Soviet Socialist Republics.

The conference was the outgrowth of earlier efforts to establish an International Pharmacopoeia. In 1902 a group of pharmacists from Brussels, in the name of the Belgian Government, issued invitations to practically all nations of the world to participate in a conference for the purpose of establishing uniformity in the definition and strength of the more potent medicines in use throughout the world.

At that time, the Pharmacopoeia of the United States was officially represented by Dr. H. C. Wood, Sr., and by Dr. Frederick B. Power. The chairman of the committee of revision, Professor Joseph P. Remington, was at that time greatly interested in this international movement and in a contribution to the conference urged the practical policy of establishing standards meeting the approval of the conference and offering these to the Pharmacopoeial Commissions throughout the world for voluntary adoption.

A second conference was called for 1914, but was postponed because of the world war. It was finally assembled at Brussels in 1925, with representatives from more than forty nations participating. Additional uniformity in standards and preparations was recommended at that time and the conference adjourned after passing recommendations that its work be taken over by the health organization of the League of Nations.

The establishment of a pharmacopoeial secretaryship, at the League, has been the basis for discussion for many years, but the actual establishment of the program has only now been completed. The chairman of the committee, Dr. Hampshire, is the secretary of the British Pharmacopoeial Commission, which has recently published the first supplement to the British Pharmacopoeia. This International Commission plans to compile a list of the more important medicines used throughout the world and invite the respective National Pharmacopoeial Commissions in various countries to prepare model monographs, which when finally approved will be presented to the Pharmacopoeial Commissions of the world with the hope that they may assist in bringing about greater uniformity.

It is hoped that the International Commission may also be able to compile the Pharmacopoeial literature of the world for the use of all Pharmacopoeial Commissions, thus avoiding the duplication of literature reviews by each nation.

CELEBRATION OF THE CENTENARY OF THE CELLULAR THEORY

THE Mexican Society of Natural History has appointed a committee to invite participation in the publication of a commemorative volume, which will celebrate the centenary of the foundation of the cellular theory by Schleiden and Schwann.

The president of the society, Dr. M. Martínez Báez, is chairman of the committee. Other members are Professor Enrique Beltrán, Dr. Alfonso Dampf and Ing. José R. Alcaraz. This committee has issued the following appeal:

> The scientific world celebrates this year the centenary of the cellular theory which was founded by the German botanist Mathias Jacob Schleiden and by the zoologist Theodor Schwann a hundred years ago. To commemorate this event, which according to E. B. Wilson, the famous cytologist, has had the same far-reaching consequences as the theory of evolution, the Mexican Society of Natural History (Sociedad Mexicana de Historia Natural) resolved at their meeting, May 6, to publish a special volume which would contain papers relating to problems of the cellular theory and kindred subjects.
>
> The undersigned committee respectfully submits the resolution to the learned sister societies of the world and begs to invite all biologists interested in the cellular theory to collaborate in the preparation of the volume. The paper which, according to the jury, is the outstanding contribution, will be awarded the Schleiden-Schwann medal of the Mexican Society of Natural History. The terms of the contest are given below. Every cytological paper is welcome, but only those which have a direct bearing on the theory will be judged.
>
> The committee hopes that the publication of a commemorative volume, with contributions by scientists of many countries, will not only serve science, but establish also friendly relations with Mexico, where research in biology has found in the last years an enthusiastic support by government authorities. The committee would be pleased if scientific societies, academies, editors of scientific reviews, etc., would insert these lines in their editions and if scientists would call the attention of their learned friends to the planned publication.

TABLET IN HONOR OF W. J. S. LOCKYER AND NORMAN LOCKYER

A CORRESPONDENT of the London *Times* reports that a memorial to the late Dr. W. J. S. Lockyer, who was the director from 1920 to 1936 of the Norman Lockyer Observatory, was unveiled on July 16. Founded by the late Sir Norman Lockyer, the distinguished astronomer, who was long editor of *Nature*, and Sir Frances McClean as a private observatory twenty-six years ago, it has since been equipped and maintained entirely by private donations. The buildings have a commanding position on the top of Salcombe Hill, Sidmouth, and visitors had an opportunity to inspect different departments. The observatory is especially equipped with telescopes and cameras.

The memorial includes a panel containing a portrait of Dr. Lockyer, surrounded by smaller portraits of Lady Lockyer, Miss Lockyer and several friends who assisted in the administration and organization of the observatory during his period of office. Beneath the panel is a cabinet containing the insignia and other records of the life and work of Sir Norman Lockyer, who died in 1920, and was succeeded as director by Dr. Lockyer, his son.

The memorial was unveiled by Sir Francis McClean. Sir Robert Mond presided, and those present included Sir Richard Gregory, chairman of the council of the observatory; Lady Lockyer, honorary treasurer; Captain W. N. McClean, honorary secretary; Mrs. J. Lockyer, Dr. H. Spencer Jones, Astronomer Royal, and D. L. Edwards, director of the observatory.

In his address Sir Richard Gregory, who succeeded Sir Norman Lockyer as editor of *Nature*, said that it ought not to be too much to hope that an observatory like that on Salcombe Hill, in which many notable contributions to progressive knowledge were being made, would not have to depend entirely upon the relatively small number of friends who had hitherto maintained it in its high position. Funds for scientific studies which led to industrial development were liberally provided in England, but a subject like astronomy, which had little direct relation to profitable industry, had to look for support to those who desired knowledge only for its own sake, whether or not it was of practical value.

It happened sometimes that such knowledge, obtained in the pure pursuit of scientific truth, was afterwards found to be of practical service. The most remarkable example of that kind was associated with the name of the founder of that observatory. When Sir Norman Lockyer discovered the element helium in the sun in 1868 no one dreamed that it would be produced daily in immense quantities, and would be used for the inflation of airships. Twenty-six years after its discovery in the sun it was found to exist in certain minerals in the earth, and after the Great War it was found to be contained in fair quantities in natural gases in some oil wells in the United States, which had practically the monopoly of the gas.

RECENT DEATHS AND MEMORIALS

DR. FREDERICK TILNEY, since 1914 professor of neurology and neuro-anatomy at the College of Physicians and Surgeons, Columbia University, died on August 7 at the age of sixty-three years.

DR. LAWRENCE F. FLICK, organizer of the Henry Phipps Institute of the University of Pennsylvania and influential in the founding of the National Tuberculosis Association, died on July 6 at the age of eighty-one years.

DR. HAROLD DICKINSON SENIOR, emeritus professor of anatomy and director of anatomical laboratories at New York University, died on August 6 at the age of sixty-seven years.

DR. LOUIS C. LOEWENSTEIN, consulting engineer, New York City, died on August 3 at the age of sixty-two years.

DR. LOUIS SHEPARD DE FOREST, practicing physician, who retired several years ago as a professor at the Yale University School of Medicine, died on August 4 at the age of eighty-one years.

ARLAND LEE MACKINNEY, in charge of forest management research at the Southern Forest Experiment Station of the U. S. Forest Service in New Orleans, was accidentally drowned on July 4. He was thirty-four years old.

E. M. NELSON, formerly president of the Quekett Microscopical Club and of the Royal Microscopical Society, an authority on microscopy and microscope construction, died on July 20 at the age of eighty-seven years.

THE centenary of the birth of Edward S. Morse, distinguished for his work in zoology and ethnology, the first professor of zoology at the University of Tokyo, was celebrated on June 25 at Tokyo under the joint auspices of the Tokyo Science Museum and the Society for Propagating Scientific Knowledge. Morse was president of the American Association for the Advancement of Science in 1886, and from 1880 to the time of his death was director of the Peabody Academy, Salem, Mass.

TRIBUTE was paid on July 22 to the memory of Charles Dawson, who, between the years 1911 and 1913, found portions of the fossil skull of Piltdown Man and in doing so discovered the remains of the earliest Englishman known. Sir Arthur Keith unveiled a monolith memorial in the grounds of Barkham Manor, Piltdown, to mark the spot on which the fossil was found. The memorial, erected by permission of David Kerr, the present owner of the manor, is of Yorkshire sandstone and stands about 5 feet in height. A large and representative company was present at the ceremony.

SCIENTIFIC NOTES AND NEWS

PROFESSOR THOMAS HUNT MORGAN, director of the Wm. G. Kerckhoff Laboratories of the California Institute of Technology, corresponding member of the Academy of Sciences, Paris, has been elected one of the twelve foreign associates of the academy.

THE Liebig Memorial Medal of the German Chemical Society has been awarded to Dr. Eduard Zintl, professor of chemistry at Darmstadt.

THE fifth award of the Dawson Williams Memorial Prize, which is given in recognition of work done in connection with pediatrics, has been made to Professor Leonard G. Parsons, professor of children's diseases at the University of Birmingham. It was presented to him at the Plymouth meeting of the British Medical Association on July 19. Professor Parsons delivered the Dawson Williams Memorial lecture, describing his work on the nutritional problems of childhood.

DR. I. W. MAGILL, senior anesthetist to the Westminster Hospital, London, has been awarded the triennial Hickman Medal, given for "original work of outstanding merit on anesthesia or in subjects directly connected therewith." The award is made by the council of the Royal Society of Medicine on the recommendation of the Council of the Section of Anesthetics.

The title of emeritus has been conferred by the University of London on Dr. J. F. Thorpe on his retirement from the university professorship of organic chemistry at the Royal College of Science; on Dr. J. C. Philip on his retirement from the university professorship of physical chemistry at the Royal College of Science, and on Professor J. T. MacGregor-Morris, on his retirement from the university professorship of electrical engineering at Queen Mary College.

Dr. Edwin E. Heizer, of the Ohio State University, has been appointed head of the new department of dairy industry of the University of Wisconsin. In addition to his work at the university Dr. Heizer has been since 1934 dairy cattle breeding specialist for the Holstein-Friesian Association of America, and for the past several years has had charge of the genetic work for the American Guernsey Cattle Club.

Dr. Edwin C. Jahn, of the New York State College of Forestry at Syracuse University, has been appointed to succeed Dr. Floyd C. Peterson as professor in the pulp and paper department.

Dr. Karl F. Oerlein, general chairman of the Pennsylvania Junior Academy of Science and professor of physics at the State Teachers College, Indiana, Pa., has been appointed head of the department of science at the State Teachers College, California, Pa.

Professor J. E. Pearce, chairman of the department of anthropology at the University of Texas, has become director of the Texas Memorial Museum. Dr. G. C. M. Engerrand, professor of anthropology, has been appointed to take his place as head of the department.

At Cornell University, Dr. Lyman G. Parratt has been promoted from an instructorship to an assistant professorship in physics.

Dr. Edward B. Doll, for the past two years teaching assistant in electrical engineering at the California Institute of Technology, and Dr. Lester Tarnopol, for the past year assistant in metallurgy in charge of the x-ray laboratory of metallurgy at Harvard University, have been appointed assistant professors in the College of Engineering of the University of Kentucky.

W. C. Krathwohl, professor of mathematics at the Armour Institute of Technology, has been appointed director of the department of educational tests and measurements.

Sir Arthur Olver, until recently animal husbandry expert, Imperial Council of Agricultural Research, India, has been appointed principal of the Royal (Dick) Veterinary College, Edinburgh, in succession to the late Principal Bradley.

Dr. Victor G. Heiser, until his retirement in 1934 associate director of the International Health Division of the Rockefeller Foundation, has been appointed research director of the Committee on Healthful Working Conditions of the National Association of Manufacturers. A survey of plant conditions will be started at once and an information service will be provided for approximately 80,000 factories employing from twenty-five to two thousand workers. Dr. Donald M. Shafer, formerly connected with the medical department of the Standard Oil Company of New Jersey, will be Dr. Heiser's assistant.

Dr. H. J. Shaughnessy has resigned his position in the department of bacteriology and public health at the University of Colorado School of Medicine and Hospitals at Denver to resume his former place as chief of the Laboratory Service of the State Board of Health of Illinois after a year's leave of absence from the latter.

Dr. Fritz Haas, formerly curator of the department of mollusks at the Senckenberg Museum in Frankfort-on-Main, has been appointed for a period of one year to the zoological staff of the Field Museum of Natural History, Chicago, as curator of lower invertebrates. Dr. Haas has come to America under the sponsorship of the Emergency Committee in Aid of Displaced German Scholars, of New York, the Jewish Welfare Fund, of Chicago, and the Field Museum of Natural History.

Dr. Donald T. Ries, son of Dr. Heinrich Ries, professor of geology at Cornell University, has been appointed park naturalist of the Illinois Starved Rock State Park. Under the sponsorship of the Illinois Natural History Survey, he will plan and conduct educational nature trips for visitors to the park. For the last year he has been working in the insect collections of the Illinois Natural History Survey at Urbana.

Dr. Luiz de Piña has been appointed head of the Institute of Criminology of the Portuguese Government. The institute replaces the Department of Criminal Anthropology, which has been reorganized on scientific lines.

David Cleghorn Thomson, formerly secretary to the Appeal Committee of the University of Oxford, has been appointed general secretary of the British Society for the Protection of Science and Learning, in succession to Walter Adams.

The following grants have been made by the Committee on Scientific Research of the American Medical Association: to Dr. Robert R. Sealock, of the School of Medicine and Dentistry of the University of Rochester, to aid in further investigation of the relationship of the metabolism of the melanin pigment precursors to vitamin C requirements; to Dr. Charles O. Warren, Jr., of the department of physiology of the Cornell University Medical College, for his work on the metabolism of bone marrow, and to Dr. Samuel R. M. Reynolds, associate professor of physiology at the Long Island College of Medicine, to support investigations on the action of oestrin on visceral and somatic small blood vessels.

Dr. Daniel Starch, consulting psychologist and director of the research department of the American Association of Advertising Agencies, delivered a series of eleven lectures on "Psychology for Living" during the week of July 11 to 16 at the Iowa State College.

Dr. R. H. Carr, professor of agricultural chemistry at Purdue University, has been given a year's leave of absence and will spend the time in Australia, where he will carry on research on soils and on plant life. He will sail from San Francisco on August 16. Dr. Carr will represent the American Association for the Advancement of Science at the Canberra meeting of the Australian and New Zealand Association at Canberra, Australia, from January 11 to 18, 1939.

Dr. Henry Field, curator of physical anthropology at the Field Museum of Natural History, Chicago, left on July 5 for an extended visit to Europe, where he will attend scientific meetings in Copenhagen, London and Brussels.

Dr. H. G. Ferguson, of the U. S. Geological Survey, left Washington on July 15 for Nevada, where he will be engaged in a study of the geology and mineral resources of the Hawthorne and Tonopah quadrangles. Field investigations of granites and related rocks in Massachusetts have been started by Dr. L. W. Currier. This work is to be conducted in cooperation with the State of Massachusetts. Dr. T. B. Nolan recently left Washington to resume studies in the Eureka and other mining districts in Nevada. Field work in the San Juan region and in the Cripple Creek district, Colorado, in cooperation with the state, has been resumed by W. S. Burbank and A. Herbert Koschmann, respectively.

The French Association for the Advancement of Science will meet at Arcachon from September 22 to 27 under the presidency of M. Guilliermond, member of the Institute of France and professor of botany at the Sorbonne.

The Government of Victoria plans to submit legislation to prevent refugee doctors from Europe, of whom forty have lately arrived, from practising in Victoria. The state has a reciprocal agreement with Italy permitting doctors qualified and registered in Italy to practise in Victoria and *vice versa;* also similar arrangements with the United Kingdom, the value of which is undermined by the action of the British medical authorities in registering refugees after an emergency course of fifteen months in a British university, though not allowing them to practise in the United Kingdom. The legislation will permit refugee doctors to practise only on completion of a course of five years in Victoria or a reciprocating country, thus overcoming the emergency registrations in the United Kingdom.

It was reported recently in the daily press that all Jewish doctors and dentists in Germany are excluded as of January 1 from "panel" practice under the Compulsory Insurance Law. As ordinary medical practice in Germany is almost entirely paid for by the government insurance association, the great majority of Jewish physicians and dentists will suffer a heavy loss. Some eight hundred Jewish doctors and dentists in Berlin are reported to be engaged, at least in part, in such panel practice. Various restrictions have been laid on them, but they have still been able to treat patients under the Compulsory Insurance Law. The ruling does not seriously affect well-known specialists, but is said to make practice almost out of the question for most Jewish physicians. A recent wireless dispatch from Bucharest reports that the Rumanian Minister of Public Works, Alexander Cuza, Jr., issued an order that all Jewish doctors employed by sickness insurance companies must immediately be replaced by doctors of the Rumanian race.

DISCUSSION

AN UNPUBLISHED MANUSCRIPT BY THE LATE BASHFORD DEAN

From a cupboard in one of the offices of the Department of Fishes in the American Museum of Natural History there has recently been routed out a considerable collection of articles published by Dr. Dean between 1908–1912, together with various notes and drawings belonging to him. To my personal knowledge these materials have not been examined in twenty years. In going through these papers in search of data bearing on the drawings of the embryos of *Chlamydoselachus* and *Cestracion* wherewith to complete the Dean Memorial Volume, I have found an unpublished note by Dr. Dean on a Japanese water snake. This note, which is dated January 20, 1909, had been packed away and forgotten.

In possible explanation of the losing of this little manuscript, the following facts may be set forth. Dr. Dean spent the winter of 1901–02 in Japan and brought back not only a splendid collection of zoological materials but a very large one of Japanese arms and armor. This collection of armor was first loaned to the Metropolitan Museum of Art and later purchased for it. Dr. Dean began to catalogue the collection in 1903 and in 1906 he was made honorary curator of arms and armor in the art museum. From this date on, more and more of his time was spent in the study of medieval armor in the Metropolitan Museum.

In 1914 Dr. Dean became full curator of arms and armor in the art museum and retained only an honorary curatorship of fishes in the American Museum of Natural History. Somewhere in the years 1909 to 1914 the mass of personal materials—the little manuscript included—was packed away in the cupboard referred to and forgotten.

The note on this snake, published herein ten years after his death, illustrates Dr. Dean's wide interest in all living things and his keen powers of observation and interpretation. Dr. G. K. Noble has read the note, has corrected the nomenclature and has suggested publication.

E. W. Gudger

Note on the Sea-snake, Pelamas Platurus (Linnaeus) by Bashford Dean

The zoologist has up to the present time given but little attention to the habits of sea-snakes (Hydrophiidae), in spite of their relative abundance and their wide distribution. He has long noted that they have become eel-like in their adaptation to purely aquatic conditions—every museum specimen tells him this—but he would none the less be surprised, I fancy, to see how utterly eel-like they have become when he observes them living.

In the aquaria at Misaki [Japan] I have kept at different times specimens of the striped *Pelamas platurus* (Linnaeus); they are curiously unsnake-like, constantly active and moving about with the least apparent effort, gliding through the water with fish-like rapidity. Their movements are obviously aided by an enlarged and flattened caudal "fin" and an outcropping ventral body wall, which serves as an anal fin. These snakes are, on the other hand, unsuited to living on land, and it is altogether improbable that they ever emerge from the waters. A specimen placed on the ground threshed vainly about like an eel—it progresses hardly more rapidly, for its vertically compressed body yields it no attachment for propulsion, and it lacks the supporting costal plates.

Numerous other adaptations to its complete aquatic life would, we might expect, be brought to light upon detailed observation. It may be worth while to record that on one of the specimens I secured the skin was notably "foul" and that young barnacles (Lepads of some species) were growing at various points, and that a large tuft of them was attached to the dorsal lobe of the tail. It was clear, accordingly, that the sea-snake had lost the ancient ophidian habit of cleaning its body surface by writhing through its coils, and it was quite possible that the period of skin-shedding was not as brief a one as in the case of its land-relatives—for in the present instance the tuft of barnacles measured nearly an inch in diameter.

This adaptation on the part of the sea-snake could easily give rise to more serious reflections. Is the fouling of the surface of the adapted form a harmful, harmless or useful character? It is harmful if it retards progression, injures the skin in the sense that it renders this organ the seat of attachment for disabling parasites of various kinds; harmless in the sense that the fouling of the cuticular surface affected only the tissue which was already in train to be sloughed off; useful if the green color of the fouled surface would make the snake inconspicuous to both enemy and prey, or if, by the fostering of edible growths, barnacles, hydroids, etc., it would provide a "bait" to various creatures upon which the snakes might feed. Each or all of these views could considerably be upheld by more or less serious people who have not the opportunity to observe and to experiment—witness the numerous and unconvincing discussions in adaptation, even during the past decade.

A TRIBUTE TO JOHN L. RIDGWAY

When John Livzey Ridgway retired from active duty as scientific illustrator for the California Institute of Technology and the Carnegie Institution of Washington on July 31, 1938, there came to a close a long and distinguished career having few parallels among workers in the natural sciences.

Urged to go to Washington from his home in Illinois by his brother Robert, who later became the eminent authority in ornithology, John L. Ridgway as a lad was first employed to make scientific drawings at the Smithsonian Institution. His ability to draw birds with great accuracy was quickly apprehended, and it was not long before his talents were sought after in other fields of natural history. His first preceptor in drawing, the late William H. Holmes, encouraged him to take the Civil Service examination for the post of draughtsman in the U. S. Geological Survey. On passing this examination and receiving an appointment under Mr. Holmes, Ridgway found himself in a small company of young illustrators, several of whom, like H. Hobart Nichols and De Lancy W. Gill, were destined to become nationally known artists.

At that time the Geological Survey and Bureau of Ethnology were under the directorship of Major Powell, and Ridgway was therefore called upon to furnish drawings not only for geology and paleontology but also for ethnology and anthropology. Ridgway later became head of the art department, the predecessor of what was then termed the Division of Illustrations of the Geological Survey, and in 1898 was appointed chief of that division. His association with the Survey continued for more than thirty years until his resignation and change of residence to California in 1920. During this long period of service countless drawings were products of his pen and brush. Ridgway's experience with the needs of authors led to the publication by the Survey of his pamphlet on the preparation of illustrations. This article received wide use and has been reprinted four times.

To pass in review the names of some authors whose contributions to science were materially aided and embellished by Ridgway's illustrations emphasizes the amazing productivity as well as versatility of this artist. His work included the execution of wash drawings of Mesozoic invertebrates for C. A. White, Cambrian fossils for C. D. Walcott, geological sections and paleontological materials for R. T. Hill, living reptiles for Shufeldt and Yarrow, fossil insects for Scudder, birds' eggs in natural color for the memoir by Bendire, fossil plants for White and for Knowlton, cephalopods for Alpheus Hyatt and later for J. P. Smith, ores and rocks in their natural colors for Van Hise and Leith, fossil crinoids for the well-known memoir by Wachsmuth and Springer, and in addition literally hundreds of pen and ink sketches on various subjects of which many have been reproduced in textbooks. It was during this period also that Ridgway was called upon for advice in matters of illustration by the newly established Carnegie Institution of Washington, and the high standards evolved in the handling of illustrative material by that institution were in a measure the result of his personal supervision.

To many men these accomplishments would have sufficed as a satisfactory life's work, but not long after his retirement to California, Ridgway was again busily engaged, at first with the Carnegie Institution and later with this institution and the California Institute of Technology, in supervising and making illustrations. During this additional period of eighteen years he was occupied for a time at Mt. Wilson Observatory, but the major part of his contributions were in vertebrate paleontology. The various paleontological papers and memoirs illustrated by him and published particularly by the Carnegie Institution give ample testimony of his skill and artistic ability. As a fulfillment of a wish and a remarkable accomplishment in itself, considering the fact that it was written by the artist late in life, is Ridgway's recently published work on "Scientific Illustration." This book, which contains a fund of information, marks a new departure in subject-matter and has received much favorable comment.

John L. Ridgway will long be remembered for his high standards in illustration. It is indeed a privilege and a pleasure to acknowledge the debt of gratitude which the natural sciences owe to this modest servant, who for more than half a century has labored to combine beauty with scientific accuracy in the delineation of fact.

CHESTER STOCK

CONTRIBUTION No. 256
CALIFORNIA INSTITUTE OF TECHNOLOGY

EDITORIAL LICENSE

IN the May issue of the *Pan-American Geologist* there appeared a paper by the writer entitled "Outlines of Kentucky Geology," the first of a series of stratigraphic articles, the manuscript for which had been submitted two months earlier. These notes are written to call attention to an example of the misuse of the editorial prerogative. Certainly in the editing of any manuscript changes both in construction and content must be approved by the author under whose name it is printed and for the statements in which he takes responsibility. This along with the final check of the page proof is accepted practice and the author's right.

Yet in the matter of the paper referred to above the writer heard nothing from his manuscript until, quite unexpectedly, the first instalment appeared in print. Errors introduced include:

(a) Plate XX—Stratigraphic Chart
  1. To make space for rearranged column headings two explanatory notes were eliminated. These notes called attention to changes made in the interpretation of stratigraphic sections taken from the work of others.
  2. To help reduce it to page size the bottom of one section was cut off along with a part of a formational name. The Camp Nelson limestone became the "Nelson" limestone.

(b) (p. 283) The Mt. Hope and Fairmont formations were reinterpreted as the Mt. Hope and Fairmont facies. There is no justification for the use of the term facies for these faunal zones.

(c) (pp. 286, 287) The Arnheim formation was changed to the Arnheim member and the Sunset and Oregonia members of that formation continued as members of that "member."

(d) (p. 268) The Saint Peter sandstone was changed to "Peter sandstone."

(e) (Pl. XIX) In retouching the outline geologic map, weighting of the eastern state boundary has made the Pine Mountain fault appear to extend north of the Breaks of the Sandy.

(f) The term High Bridge is changed to Highbridge on page 269 and left as High Bridge on page 268. This is a matter of not misspelling but inconsistency.

(g) An occasional misspelled word which the author had no opportunity to correct in the galley proof.

(h) A tabular outline of formations which would have clarified the text was eliminated.

There are few manuscripts that may not be improved through proper editing, but the question is not one of the desirability or undesirability of any changes. It is one of responsibility on the part of the author for the contributions printed under his name and his right of approval of these changes before the article comes from the press. The editor has been notified that the manuscript is to be returned and that no further instalments be printed.

Arthur C. McFarlan

University of Kentucky

SOCIETIES AND MEETINGS

THE CONFERENCE ON ALGEBRA AT CHICAGO

The intense current interest in algebraic research was exemplified in a conference on algebra at the University of Chicago from June 28 to July 1. It followed a conference at Notre Dame in February on the algebra of geometry and a symposium of the American Mathematical Society at Charlottesville, Virginia, in April on the "structure" or "lattice" theory of algebraic systems. The success of these meetings has demonstrated the effectiveness of mathematical conferences devoted to the study of a single topic.

The Chicago conference was concerned largely with linear algebras and algebraic geometry. It opened on Tuesday morning with an address by Professor L. E. Dickson, of the University of Chicago. He traced the history of quaternions and other linear algebras. Some of the rules of ordinary algebraic manipulation do not apply to these algebras; in particular, $xy = yx$ is not always true. However, the algebras still include "integral" elements with many of the properties of ordinary whole numbers. Professor Dickson described the long and difficult search for these numbers and their final discovery.

New and explicit formulas for sets of whole numbers in certain important algebras, the cyclic algebras, were presented by Professor R. Hull, of the University of Illinois. Professor C. G. Latimer, of the University of Kentucky, explained how the arithmetical properties of the integral sets in quaternion algebras are closely related to properties of quadratic and hermitian forms. These arithmetical properties depend on certain sets of elements, called ideals. Professor MacDuffee, of the University of Wisconsin, explained how many of the computations with such ideals could be carried out by the use of matrices.

A new and very general process for the reduction of hermitian and related types of matrices to canonical forms was outlined by Professor J. Williamson, of Johns Hopkins. Professor M. H. Ingraham, of the University of Wisconsin, explained how certain reductions to canonical forms can be simplified by replacing a matrix by a smaller matrix whose elements are themselves in a division algebra.

The algebras found by combining division algebras with algebras of all n-rowed square matrices were analyzed by Professor R. Brauer, of the University of Toronto. Professor A. A. Albert, of the University of Chicago, gave a new proof for some properties of the algebras built up by combinations of cyclic algebras. Cyclic algebras constructed from numbers with certain continuity properties were analyzed by Dr. O. F. G. Schilling, of Johns Hopkins. Certain related arithmetical devices were used by Professor Artin, of Notre Dame, for the solution of quadratic equations homogeneous in several variables.

Professor R. Baer, of the University of North Carolina, investigated the extent to which the structure of a commutative group is determined by the inter-relations of its subgroups. Dr. N. Jacobson, of the University of North Carolina, explained the structure of Lie algebras. One example of such algebras is furnished by ordinary vectors, using vector multiplication.

Considerable controversy attended the presentation of papers on Wednesday on curves and surfaces defined by algebraic equations. Professor S. Lefschetz, of Princeton, declared that many results in such geometry previously found by analytical methods could be obtained by simple algebraic devices. There was a lively discussion of the role of such methods. After the formulation by Dr. S. MacLane, of the University of Chicago, of certain algebraic tools which characterize the points on a curve, Professor O. Zariski, of Johns Hopkins, made elegant applications of such methods to the simplification of singular points of surfaces.

On the second day of the conference a dinner was held in Judson Court for visiting and local mathematicians. More than 140 enjoyed the dinner and the ensuing speeches. One speaker stated that over 90 graduate students are in residence at the university this summer.

The university's program of mathematics this summer emphasizes algebra. In addition to the regular courses, there is a seminar on algebra conducted by members of the staff.

S. MacLane
G. B. Price

EIGHTH ANNUAL FIELD CONFERENCE OF PENNSYLVANIA GEOLOGISTS

THE eighth annual meeting of the Field Conference of Pennsylvania Geologists was held in Maryland, West Virginia and Virginia from May 27 to 30, inclusive. The total attendance of 96 members and guests included, besides *Pennsylvanians*, geologists from the U. S. Geological Survey, New York, New Jersey, Massachusetts, Delaware, Maryland, West Virginia and Virginia.

The conference hosts were the members of the Virginia Geological Survey. The 1938 committee consisted of Dr. Arthur B. Cleaves, *chairman;* Dr. Arthur Bevan, state geologist of Virginia, *local chairman;* Professors F. M. Swartz and R. E. Sherrill.

On Friday evening an assembly was held in Cumberland, Md., and details of the following day's stratigraphic trip explained by Dr. Frank M. Swartz.

On Saturday the entire conference participated in a field excursion covering strata ranging from Upper Cambrian to Upper Devonian, in the area lying between Cumberland, Md., Keyser, W. Va., and Winchester, Va. Drs. Frank M. Swartz and Charles Butts were the leaders.

The annual dinner was held at the George Washington Hotel in Winchester on Saturday evening. A welcome was extended to the conference by the president of the Winchester Chamber of Commerce. Other speakers were Dr. Arthur B. Cleaves, 1938 chairman, of the Pennsylvania Topographic and Geologic Survey; Dr. Arthur Bevan, local chairman, state geologist of Virginia; Dr. Charles Butts, of the Virginia Geological Survey; Dr. Frank M. Swartz, of Pennsylvania State College; Dr. Wm. M. McGill, assistant state geologist of Virginia, and Dr. Bradford Willard, of the Pennsylvania Topographic and Geologic Survey, who was the official representative of the conference at the International Geological Congress in Russia in 1937.

The field excursion on Sunday, led by Dr. Swartz and Dr. Butts, from Winchester to Luray, Va., covered strata from Upper Cambrian to Upper Devonian and included a study of the Massanutten Mountain syncline. In the evening a complimentary trip through Luray Caverns was enjoyed by the conference.

On Monday morning the party was led by Mr. George W. Stose, of the U. S. Geological Survey, from Luray to Panorama and Front Royal and studied the pre-Cambrian-Cambrian complex exposed on the north half of the Skyline Drive.

The conference as a whole disbanded at Front Royal on Monday noon, but a small group under the leadership of Dr. Arthur Bevan traveled to Leesburg, Va., and examined the Triassic beds exposed there.

The 1939 field conference will be held in West Virginia, where the West Virginia Geological Survey will be hosts. Members of the committee for the 1939 conference are: Dr. Paul Price, state geologist of West Virginia, *chairman;* Professor Benj. L. Miller, Department of Geology, Lehigh University; Professor R. E. Sherrill, Department of Geology, University of Pittsburgh, and Dr. Arthur B. Cleaves, secretary-treasurer, of the Pennsylvania Topographic and Geologic Survey.

The guide book for the 1938 conference was prepared in permanent form as a special bulletin of the Virginia Geological Survey. It is the first of a series planned by that state. It can be obtained from the state geologist of Virginia and the title is: Guidebook Field Conference of Pennsylvania Geologists, Virginia, 1938. Guide Leaflet No. 1.

ARTHUR B. CLEAVES,
Secretary.

SPECIAL ARTICLES

THE STRUCTURE OF THE INSULIN MOLECULE

ON the basis of the Cyclol hypothesis,[1] a structure C_2 was proposed for the insulin molecule.[2, 3] C_2 is a cage structure consisting of a fabric carrying side chains, bent over a truncated tetrahedral framework.[2] The only metrical parameter, a (a mean between C–C and C–N bond lengths), taken[2] as 1.5 A, defines the dimensions of C_2. C_2 molecules with axes parallel fit the rhombohedral cell of the insulin lattice given by an x-ray analysis.[4] They can be arranged with any orientation α in the corresponding hexagonal cell, and α was necessarily left undetermined.[3] Further data, namely, Patterson-Harker diagrams, have now become available.[5]

It has been stated that these diagrams are incompatible with the structure I proposed for insulin.[5] I have therefore made a study of the Patterson-Harker diagrams given by C_2. The skeleton of C_2 is a truncated tetrahedron with six slits whose centers give an octahedron of side $l = 8\sqrt{6}a$. All the vectors between points on its framework lie on or within a truncated octahedron of side $2l = 16\sqrt{6}a = 58.8$ A. Postulating concentrations of atoms near these six octahedral

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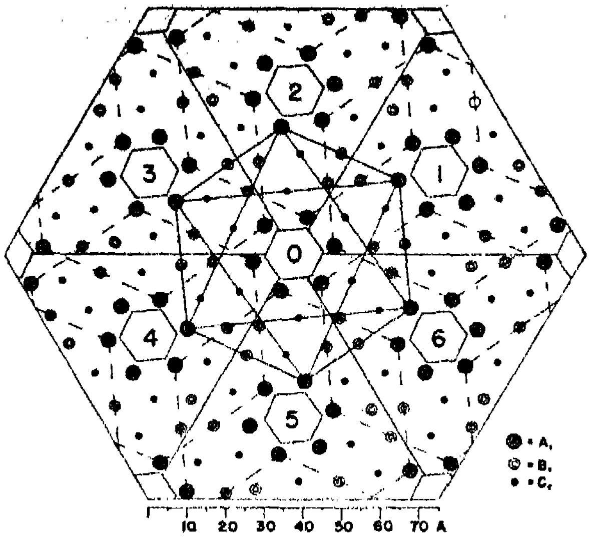
[1] Wrinch, *Nature*, 137: 411, 1936; *Proc. Roy. Soc.* (London), 160A: 59, 1937.

[2] Wrinch, *Nature*, 139: 972, 1937; *Proc. Roy. Soc.* (London), 161A: 505, 1937.

[3] Wrinch, SCIENCE, 85: 566, 1937; *Trans. Faraday Soc.*, 33: 1368, 1937.

[4] Crowfoot, *Nature*, 135: 591, 1935.

[5] Crowfoot, *Proc. Roy. Soc.* (London); 164A, 580, 1938.



points of the C_2 we obtain Patterson-Harker peaks for a molecule at 0 which lie at the corners and midpoints of the sides of the octahedron $2l$ with center at 0. The figure shows the projection on the c-plane of these 18 peaks giving a hexagon with center at 0, with side length 33.9 A. There are six at its corners, six at the midpoints of its sides and six at the midpoints of lines joining alternate corners; indicated for convenience as A, B and C, respectively.

We now notice that Crowfoot's c-plane projection also gives 18 peaks per molecule, reproduced in Fig. 1, which fall into a pleasing pattern of hexad, triad and dyad sets. Superposing the C_2 hexagon on this diagram, we turn this hexagon about its center, through an increasing angle α until any of its points falls upon a Crowfoot peak. We find with $\alpha = 6°$ that all A peaks fit on A peaks, B peaks on B peaks and C peaks on C peaks, as shown in Fig. 1.

This procedure allocates to the molecule at 0 one A peak in each of the hexad sets surrounding the points 1,2,3,4,5,6; the most remote B peak of each neighboring triad set; the near C peak of each neighboring dyad set. Drawing corresponding hexagons around other molecules all the A, B and C peaks are filled in. The six nearest A and B peaks around O are contributed, one each, by the molecules associated with the positions 1,2,3,4,5,6, and none of them by the molecule at 0.

So far the details of the skeleton and the positions of the side chains attached to the C_2 molecules have been left out of account. Nevertheless, the 18 peaks per molecule in Crowfoot's c-plane projection are given in the correct positions, on the assumption that there are concentrations of atoms at the six slits.

The full investigations will shortly be published. They show the direct relation between the diagrams obtained from the C_2 structure and all the diagrams given by Crowfoot and include also an account of the geometric method of interpreting Patterson-Harker diagrams in general, both for molecules and for megamolecules.

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l-GLYCERIC ALDEHYDE AND TUMOR METABOLISM

It was reported some years ago that dl-glyceric aldehyde inhibits glycolysis of tumor cells.[1] Under *anaerobic* conditions glycolysis is inhibited about 75 per cent. by 10^{-3} M. and almost completely stopped by 1.5×10^{-3} M. This applies *to all malignant tumors, i.e.*, to human and animal tumors, to spontaneous tumors and tumors transplanted or produced by carcinogenic substances, to sarcoma as well as to carcinoma, whether filterable or non-filterable. The *aerobic* glycolysis of tumors is less sensitive to glyceric aldehyde; 4×10^{-3} M. are required for an inhibition of about 75 per cent.

Some months ago J. Needham and H. Lehmann[2] found that d-glyceric aldehyde does not affect glycolysis of embryos. Nor does it inhibit glycolysis of tumors, as we have shown in a previous communication.[3] The effect of dl-glyceric aldehyde thus seems to be due to the l-form, and therefore it was of interest to examine the action of this isomeride.

H. O. L. Fischer and E. Baer recently succeeded in preparing pure l-glyceric aldehyde.[4] With this substance experiments were carried out on tumor slices, and it was found that l-glyceric aldehyde is about twice as effective as the racemic form. A slight inhibition (about 25 per cent.) of the anaerobic glycolysis of tumors is obtained with concentrations as low as 3×10^{-4} M., glycolysis is inhibited about 75 per cent. by 5×10^{-4} M. l-glyceric aldehyde, and almost completely stopped by 7.5×10^{-4} M. (see Table 1).

TABLE 1
Anaerobic Glycolysis of Rat Sarcoma 39

l-Glyceric Aldehyde M/litre	$Q_{CO_2}^{N_2}$ (second half hour)
......	37.7
3×10^{-4}	27.2
5×10^{-4}	8.8
7.5×10^{-4}	3.7

Under aerobic conditions 2×10^{-3} M. l-glyceric aldehyde inhibits glycolysis about 75 per cent.

---

[1] B. Mendel, *Klin. Woch.*, 8: 169, 1929.

[2] J. Needham and H. Lehmann, *Biochem. Jour.*, 31: 1913, 1937.

[3] B. Mendel, F. Strelitz and D. Mundell, *Nature*, 141: 288, 1938.

[4] E. Baer and H. O. L. Fischer, Science, July 29, p. 108.

The rotation of an aqueous solution of l-glyceric aldehyde, if kept in the ice-box, changes in a week's time from $[\alpha]_D^{20^\circ} -14$ to about -7. Dr. Baer has been able to restore the original optical activity of such a solution by evaporating it and heating the residue to 55–60° C. *in vacuo* for 2 hours. We found that the decrease in optical rotation is not accompanied by any noticeable change in the biological activity: both solutions whether $[\alpha]_D^{20^\circ}$ was -7 or -14 were found to inhibit glycolysis to the same degree when used in equal concentrations.

As dl-glyceric aldehyde (0.5×10^{-2} M.) is known to inhibit respiration of brain cells, experiments were carried out to decide whether this effect is due to the l- or to the d-component. It was found that the inhibition is brought about mainly by l-glyceric aldehyde, whereas the d-form has only a slight effect on respiration. (See figure).

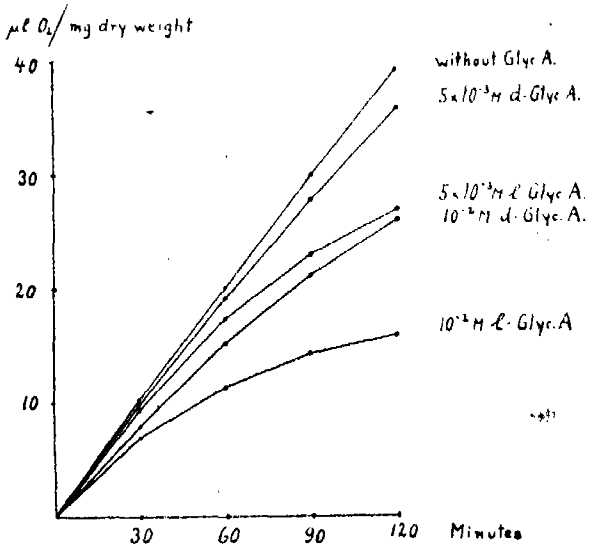

FIG. 1. Effect of d- and l-glyceric aldehyde on respiration of rat brain (grey matter) Ringer Phosphate, pH = 7.4.

The respiration of tumors is less sensitive to glyceric aldehyde than the respiration of brain, and the differences between the two optical forms were found to be less marked in experiments on sarcoma 39.

d- and l-glyceric aldehyde are fermented at the same velocity by slices of rat liver under anaerobic conditions.

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A THEORY OF CORTICO-ADRENAL AND POST-PITUITARY INFLUENCE ON THE KIDNEY

THE possibility of an important relationship between the adrenal cortex and the posterior pituitary lobe in regard to their actions on the kidney has been discussed in previous papers.[1,2,3] We have recently carried out experiments which confirm our earlier work and give fairly clear indication of the mode of action of the hormones concerned. Tests were made of responses of female opossums to orally administered water, salt and urea, and the influence of cortico-adrenal extract and post-pituitary solution (Squibb) was determined. Both normal and adrenalectomized opossums were utilized, and more than three hundred separate experiments were made in this study.

The results are given in summary in Table 1. It will be observed that in every case the action of cortico-adrenal extract on chloride excretion (per cc of urine) by the kidney is the direct opposite of that of the post-pituitary effect. Further, in every case the elimination of water under the influence of adrenal extract is greater than that under post-pituitary solution. It would appear that the latter hormone acts to bring

TABLE 1

EFFECT OF CORTICO-ADRENAL EXTRACT AND POST-PITUITARY SOLUTION (SQUIBB) ON RENAL SECRETION

Fluid administered†	Hormone administered	Normal opossums			Adrenalectomized opossums		
		Average water output, cc.*	Concentration in mgm./cc.		Average water output, cc.*	Concentration in mgm./cc.	
			Chlorides	Urea		Chlorides	Urea
Water	none	16.4	0.21	4.51	8.1	0.32	6.66
	cortico-adrenal extract	17.6	0.32	3.58	10.9	0.30	4.91
	post-pituitary solution ...	5.7	6.50	18.2	3.0	1.72	25.0
NaCl (0.9 %)	none	13.2	7.12	6.51	5.2	7.50	10.2
	cortico-adrenal extract	22.0	6.37	4.18	12.2	4.58	7.60
	post-pituitary solution ...	17.0	10.0	6.77	8.8	11.1	10.3
NaCl (0.9 %) plus Urea (2 %)	none	10.0	7.60	40.6	8.8	4.20	38.6
	cortico adrenal extract	15.2	6.31	27.2	13.3	3.31	33.3
	post-pituitary solution ...	14.8	8.51	26.5	...	...	...

† 20 cc./kilo body weight/2 hours.
* Each figure represents an average of 12–21 metabolic runs. Water excretion on basis of cc/kilo body weight/2 hours.

---

[1] H. Silvette, *Am. Jour. Physiol.*, 117: 405, 1937.

[2] H. Silvette and S. W. Britton, *Am. Jour. Physiol.*, 121: 528, 1938.

[3] H. Silvette, *Proc. Am. Physiol. Soc.*, fiftieth annual meeting, Baltimore, 1938, p. 188.

about a highly concentrated urinary output, containing large amounts of both chlorides and urea, while the hormone of the adrenal cortex induces a large urinary volume having a relatively low concentration of urea and chlorides. It is noteworthy, too, that the concentrations of both urea and chlorides in the urine tend to vary together, in one direction or the other, according to the hormone used.

A true diuretic substance is said to be one which will "consistently and reproducibly elevate the urine flow, as determined by catheterized specimens in well-controlled experiments, from moderate rather than very low levels; the diuresis should reach a rate at least comparable to that observed after a moderate dose of water, and it should persist for a period of at least 30 minutes."[4] In our experiments the hormone of the adrenal cortex as a diuretic factor fulfils these conditions in every respect.

The hypothesis that the cortico-adrenal hormone acts as a diuretic agent and in antagonism to the antidiuretic hormone of the posterior lobe of the pituitary explains the puzzling fact that hypophysectomized animals show only a transient polyuria, while animals from which the posterior lobe alone is removed show a persistent diuresis. When the posterior lobe only is excised, lack of its antidiuretic hormone plus the presence of the diuretic adrenal hormone would lead to polyuria through decreased water reabsorption from the renal tubules. When both lobes are removed, the uncompensated activity of the diuretic cortico-adrenal hormone would persist until the adrenal cortex (in the absence of the corticoadrenotropic hormone of the anterior lobe) becomes atrophic, at which time both posterior-lobe antidiuretic hormone and cortico-adrenal diuretic hormone would be absent from the bloodstream and polyuria would disappear.

From many considerations, now omitted for lack of space, it appears that while post-pituitary action may be exerted chiefly in the direction of inhibition of the aqueous portion of urinary excretion by the kidney, the influence of cortico-adrenal extract (in so far as its renal action is concerned) is directed towards increased water elimination. Thus the present experiments seem to establish the physiological antagonism of the post-pituitary and cortico-adrenal principles in their action on urinary secretion.

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---

[4] H. W. Smith, "The Physiology of the Kidney," New York, 1937, p. 229.

ISOLATION OF THE FUNGUS CAUSING THE RED STELE OR RED CORE DISEASE OF STRAWBERRIES

A SERIOUS root rot of the strawberry was described in Scotland in 1926, under the name "Lanarkshire disease."[1] The term "red core root" was proposed for the disease in 1929,[2] as being descriptive of its most characteristic symptom. A disease presumably identical with "red core root" was first reported in the United States in 1935 from Illinois, under the name "black-stele root rot."[3] In 1937[4] the "black stele" or "red stele" disease was reported from Virginia, Maryland, New Jersey, New York and Michigan, in addition to Illinois. This disease now appears to be spreading in the Middle Atlantic States and is becoming decidedly injurious in restricted areas where soil and climate are favorable to its development.

The red-stele disease may be easily distinguished from other strawberry root rots by the fact that the causal organism, while completely destroying fine, fibrous roots, advances up the central cylinders of larger roots, killing the interiors and causing them to turn dark red, while the surrounding cortex still appears alive and healthy. The fungus eventually advances to the stem of the plant, but apparently does not invade it. The larger roots die gradually, beginning at the distal ends, some time after the steles have been killed. As a consequence of the injury to the root system, affected plants wilt, older leaves die, and newly formed leaves remain very small with conspicuously short petioles. Badly diseased plants often succumb during the heat of spring and summer, but lightly affected plants grow normally through the summer, only to suffer a renewed attack by the fungus late in the season.

Red stele was first attributed to such causes as poor cultural conditions and parasitism by mycorrhizal fungi and by Pythium species. Since 1929[5] there appears to have been general agreement that the disease is caused by an undetermined species of Phytophthora. Oospores of the Phytophthora type occur commonly and abundantly in diseased roots, and sporangia and zoospores characteristic of the species may be induced by submerging recently infected young fibrous roots in cool water for a period of 18 hours or more. However, a survey of the literature discloses that previous attempts to isolate the fungus and grow it in pure culture have been unsuccessful. In the absence of pure cultures of the organism, it has necessarily been impossible to prove conclusively that the associated Phytophthora causes the disease.

---

[1] Claude W. Wardlaw, "Lanarkshire Strawberry Disease, a Report for the Use of Growers (with preface by Professor J. M. F. Drummond)". Carluke (Scot.). Printed by J. Bell, 1926. Issued by Botany Department, University of Glasgow.

[2] Nora L. Alcock, Gard. Chron., 3 (86): 14–15, illus., 1929.

[3] H. W. Anderson, *Phytopathology*, 25: 5, 1935.

[4] J. B. Demaree and G. M. Darrow, U. S. D. A. *Plant Dis. Rptr.*, 21 (22): 394–399, December 1, 1937.

[5] Nora L. Alcock, *op. cit.*

The present note reports successful isolation of the Phytophthora from strawberry roots, proof of its pathogenicity, and some comments on its behavior in culture.

The fungus was isolated in November, 1937, from roots of diseased strawberry plants growing on the U. S. Horticultural Station farm at Beltsville, Md. Fall roots were well developed at the time, and the fungus was actively attacking the distal fibrous roots and had advanced a short distance up the steles of some of the main roots. Large roots with diseased steles but healthy cortex were thoroughly washed in sterile water, the cortex was carefully removed under aseptic conditions, and the upper 2 cm of the diseased zones were cut in pieces about 5 mm long. The pieces were mounted in a hardened drop of water agar on a coverglass, covered with an additional drop of agar, and inverted over a Van Tieghem cell. Growth of hyphae was followed under the microscope, and either developing hyphae or the entire root pieces, whichever seemed advisable from appearances, were transferred to test-tubes. Approximately 50 per cent. of the pieces yielded Phytophthora in pure culture, or contaminated only with bacteria, which were later eliminated from the cultures. A similar series of isolations from diseased plants collected by Dr. H. W. Anderson near Vermilion, Ill., late in March, 1938, yielded only 4 cultures of Phytophthora out of 45 isolations, most of the others giving a species of Pythium which evidently follows the Phytophthora very closely in the roots.

Pathogenicity was proved by inoculating mycelial cultures and zoospores to roots of potted strawberry plants which had been previously rooted from runners in autoclaved soil. Zoospore inoculation proved to be the simplest method. Abundant infection and some oospore production in fine roots was present six days after inoculation. Under greenhouse conditions wilting began three weeks after inoculation, and at this time the root systems were almost completely destroyed, showing all the characteristic symptoms of naturally infected plants. The organism was recovered in pure culture from inoculated plants by the method used in the original isolations, from the reddened steles of affected larger roots. Uninoculated check plants remained healthy.

The identity of the species is still being investigated. As had previously been determined[6] on its host plant, the fungus belongs to the group of Phytophthoras having large, non-papillate sporangia, comparatively large oospores and predominatingly amphigenous antheridia; but cultural and cross-inoculation studies have so far failed to place it accurately in any described species.

In culture, the Phytophthora grows best on oatmeal agar and in canned pea broth,[7] and somewhat less rapidly on lima-bean agar. Growth is unsatisfactory on all other media tried, including cornmeal agar. Neither sporangia nor oospores have occurred in the culture media tested up to the present time, but sporangia and zoospores develop in abundance when small blocks of mycelium, grown in thin layers of lima-bean agar, are shallowly irrigated with cool tap water. The fungus has a relatively low temperature range, mycelium being killed in one week at 30° C., while zoospores are produced at 10° C., but are inhibited at 22° C., the range of maximum production lying between 14° and 18° C. It is perhaps needless to point out that, together with mechanical distribution of diseased plant parts, zoospore dispersal constitutes the principal means of spreading the disease in the field.

Spore and sporangial measurements of the American red-stele organism come well within the range described for the Phytophthora associated with the Lanarkshire disease in Scotland, and since the symptoms are also similar in most respects, it appears probable that the two diseases are identical.

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SCIENTIFIC APPARATUS AND LABORATORY METHODS

THE MEASUREMENT OF THE EXTERNAL FORCE IN WALKING

For an adequate study of human locomotion it is necessary to measure with considerable precision the force exerted on the substratum by the foot at each instant during progression. Since this force is the resultant of the force of gravity and the reaction to the acceleration of the body at the moment, its measurement provides a means of determining the acceleration and so of the force concerned in the movement of the body as a whole. Three measurements are necessary if the force is to be known both as to magnitude and direction. This can best be accomplished by measuring the force in three constant directions, in practise the three axes of rectangular coordinates.

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[6] Ibid.

[7] L. H. Leonian, *W. Va. Agr. Exp. Sta. Bull.*, 262 (p. 13), 36 pp., 1934.

In order to know the torque with which this force acts on the body, it is necessary, in addition, to know the position of the force. Since the horizontal components are situated in the plane of the platform upon which the subject walks, it is only necessary to determine the position of the vertical component in the horizontal plane to effect a complete determination of the force. This position was determined by Elftman and Manter[1] from cinematic records of the distribution of pressure in the sole of the foot, but it can be more easily achieved with the apparatus here described.

The base of the apparatus is so arranged that it can be suspended between two tables. Resting on this base are four vertical compression springs, supporting the lower of two platforms. When a force is exerted on the platform at any point the total compression in the springs measures the vertical component of the force. The relative distribution of this force between the springs depends on the position of the vertical component with respect to the plane of the platform. The quantities to be measured are three in number; it is most convenient to use the vertical displacement of the platform at points 1, 2 and 3 of the diagram. If the displacement is calibrated in terms of the force required to produce it, the sum of the displacements at points 1 and 3 will give the total vertical force and the position of this force can be obtained by equating moments. Although designed for the investigation of movement, this apparatus can also be used for the more traditional measurement of the position of the center of gravity when the body is stationary.

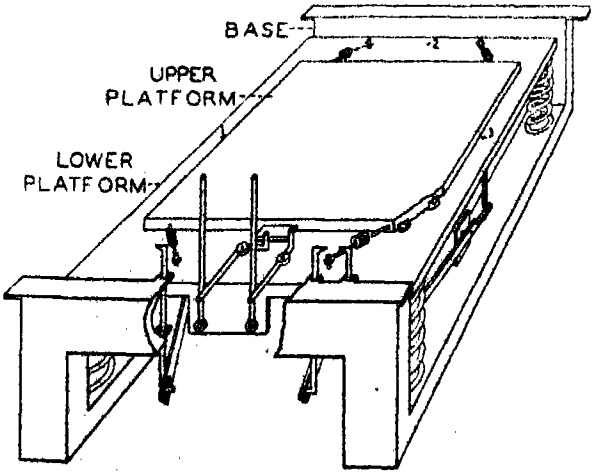

FIG. 1

The horizontal components of force may be measured by means of the displacement of the lower platform in the horizontal plane, since this depends on bending of the springs with respect to their vertical axes. This was proven to be a reliable method by Manter in his investigations on feline locomotion in this laboratory. With the human subject it has been preferable to measure the horizontal components by means of a second platform, parallel to the lower one but separated from it by ball bearings and attached to horizontal springs. From the displacement of the upper platform the components of the force in the direction of movement and lateral to it can be obtained.

The problem of recording the five displacements may be met in various ways. For walking it has been adequately accomplished by lever systems so arranged that the displacements are magnified without distortion and produce movements of indicating levers, all five of which are located in one plane. The indicating levers are photographed with a high-speed cine-camera, the actual speed of which is calculated from the oscillations of a pendulum placed in the photographic field. This camera also provides a record of the position of the foot. For analysis of locomotion another camera is used simultaneously to record the position of the entire individual, walking behind a rectangular grid.

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[1] H. Elftman and J. Manter, SCIENCE, 80: 484, 1934.

A PHOTOELECTRIC COLORIMETER

THIS apparatus is the result of an attempt to construct a photoelectric colorimeter which is relatively inexpensive but both highly accurate and sensitive. Many of the colorimeters available measure the current produced by a single photoelectric cell, a procedure which requires a constant light source, the constancy of which is maintained by variable resistances in the lamp circuit,[1,2] by a trickle charger on to a storage battery,[3] or by a diaphragm placed between the lamp and absorption cell.[4] Some of the difficulties with this method of employing a single cell arise from the variations in the current produced by the cell caused by fatigue and changing temperature. These difficulties can be avoided or minimized by using a variable resistance and a galvanometer as a null point indicator to balance the output of two photoelectric cells connected in opposition.[5] Goudsmit and Summerson[6] employed a balanced circuit, but effected the balance by changing the thickness of the layer of solution through which one of the beams of light passed.

---

[1] A. Weil, SCIENCE, 79: 593, 1934.

[2] K. A. Evelyn and A. J. Cipriani, *Jour. Biol. Chem.*, 117: 365–369, 1937.

[3] I. M. Diller, *Jour. Biol. Chem.*, 115: 315–322, 1936.

[4] C. Sheard and N. H. Sandford, *Jour. Lab. and Clin. Med.*, 14: 558–574, 1929; 15: 483–489, 1930; *Am. Jour. Clin. Path.*, 3: 405–420, 1933.

[5] H. Hartmann, *Ergeb. d. Physiol.*, 39: 412–449, 1937.

[6] A. Goudsmit, Jr., and W. H. Summerson, *Jour. Biol. Chem.*, 111: 421–433, 1935.

The instrument herein described utilizes a balanced circuit, but the balance is achieved by the use of a variable resistance in circuit of one of the photoelectric cells. The apparatus consists of a Leeds and Northrup 2420-c galvanometer, the light of which has been replaced by a 21 c-p. headlight bulb supplied with a 7-volt current from a transformer fed by ordinary house current (110 volts, alternating current). One photoelectric cell (General Electric, Cat. No. 4120833 G 1) is fastened to each side of the galvanometer box after a small window has been cut to allow the passage of light. Interposed between the lamp and the photoelectric cells are 2-inch square light filters, selected from molded filters of Corning Glass Works to transmit only light of the wave-length absorbed by the substance being analyzed, and absorption cells made by drilling a ¾-inch hole in a 1-inch Lucite block (du Pont). The filters, absorption cells and photoelectric cells are shielded to exclude all light save that coming from the lamp. The photoelectric cells are connected in opposition with a decade resistance (Leeds and Northrup, Cat. No. 3976) in the circuit to reduce the output of the left photoelectric cell. The apparatus is illustrated in Fig. 1. The materials and parts cost about one hundred dollars.

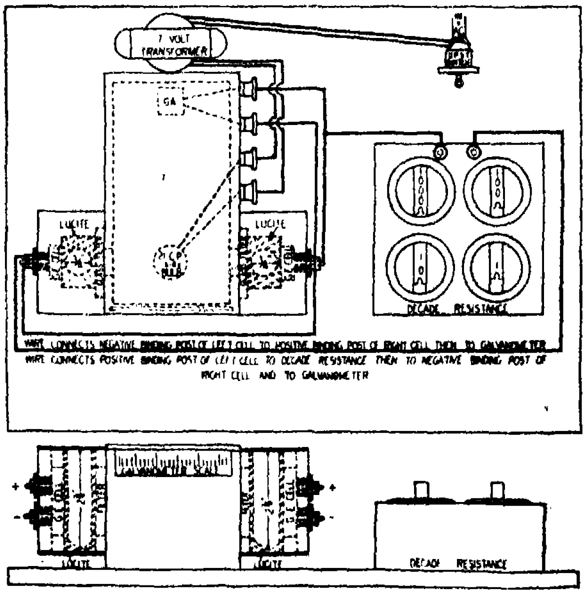
7 VOLT TRANSFORMER
GA
LUCITE
LUCITE
21 C.P. BULB
DECADE RESISTANCE
WIRE CONNECTS NEGATIVE BINDING POST OF LEFT CELL TO POSITIVE BINDING POST OF RIGHT CELL THEN TO GALVANOMETER
WIRE CONNECTS POSITIVE BINDING POST OF LEFT CELL TO DECADE RESISTANCE THEN TO NEGATIVE BINDING POST OF RIGHT CELL AND TO GALVANOMETER
GALVANOMETER SCALE
+
-
+
-
LUCITE
LUCITE
DECADE RESISTANCE

FIG. 1. Schematic drawing of photoelectric colorimeter. Upper drawing—vertical view. Lower drawing—frontal view.

The colorimeter has been employed so far only in the determintion of creatinine concentrations, using the alkaline picrate method. For this Corning filters No. 428 were used. The alkaline picrate diluted 1 : 2 with water is placed in both the right and left absorption cells and the galvanometer balanced, the reading in ohms representing the blank. After this blank determination the fluid is removed from the right cell by suction. To 20 cc of a creatinine solution 10 cc of alkaline picrate is added and the right absorption cell filled with the mixture. The galvanometer is balanced 12 minutes after the creatinine and alkaline picrate are mixed. The blank is subtracted from this reading. A calibration curve, based on triplicate determinations of dilute creatinine solutions, is shown in Fig. 2. The instrument is most accurate in determining low concentrations.

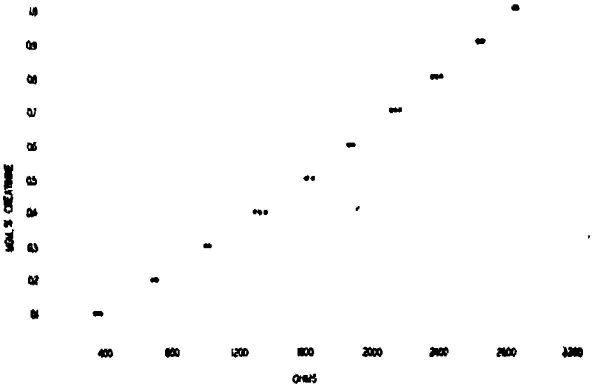

FIG. 2. Calibration curve of determinations of creatinine concentrations with photoelectric colorimeter.

A filter may be substituted for the left absorption cell and a receptacle containing a test-tube used in place of the Lucite cell on the right. The Lucite cells have given more accurate results and, while test-tubes can be used more conveniently, we have preferred to retain the more accurate and slower method.

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LOGIC AND PROBABILITY IN PHYSICS[1]

By Dr. CHARLES GALTON DARWIN

MASTER OF CHRIST'S COLLEGE

THE history of the development of physics in the first quarter of the twentieth century will rank as one of the greatest in the advancement of knowledge, but it will also rank as one of the most curious in the history of human thought. In 1901 Planck started the quantum theory. Even this was curious. He was trying to find out the law of complete radiation by the use of ordinary statistical methods, and observed that he got his answer at what should have been the last stage but one of his work. The last stage would have involved proceeding to a limit, and he found that he got the experimental answer without doing so, and an absurd answer if he did. The work went rather deep into statistical theory and there were many for long afterwards who were not convinced of its compelling force, but it was the great merit of Planck that he knew that he had got something involving a quite revolutionary idea—the quantum. In succeeding years other phenomena were seen to involve the same revolutionary idea: Einstein's theory of the photoelectric effect and of the ionization produced by x-rays, his theory of specific heats, later improved by Debye, and Bohr's theory of spectra. All these things fitted in quite obviously with the quantum, but quite as obviously they violently contradicted the physics of the nineteenth century. What should a man think about a beam of light which according to Einstein had to be composed of arrows, whereas a hundred years earlier Fresnel had *proved* that it was a sys-

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[1] Concluding portion of the address of the president of the section of mathematical and physical science of the British Association for the Advancement of Science, meeting at Cambridge from August 17 to 24.

[illegible] waves. What does a rational being do when faced with two mutually contradictory but both indubitable pieces of evidence? It was a nice test for the critical spirit, and it revealed a wide divergence of choices. In making a historical judgment long after the event, one of the hardest things to do is to recall the relative scale of importance which contemporaries were inclined to attach to the different branches of their subject.

The statistical theory of matter had already been well established by the work of Maxwell, Boltzmann and Gibbs, but it was not regarded as an essential part of a general mathematical-physical education. For example, in the various courses I was advised to undertake during my undergraduate career, no one at any stage ever suggested to me that I should learn anything about the kinetic theory of gases. I think that that period was one when the Cambridge mathematical school was not at its best, and very probably a little more was done at other places, but, to judge by the available text-books in any language, statistical theory was not regarded as one of the prime subjects of study, as it would be now. The period was essentially dynamic, and as such it was moderately easy for it to take in the new ideas of relativity, to which indeed the experimental work of the last century had been leading. But there was no common habit of thought on statistical lines, and so there was a sharp separation of opinion. The seniors, impressed with the vast mass of successful physics of the nineteenth century, with only a rather general knowledge of statistical theory but no facility of thought in it, found the new ideas completely contrary to their convictions. Such men would think that these ideas depended on the difficult and unfamiliar conceptions of statistics and would be inclined to judge that there must be a fallacy in the statistics which would be cleared up later. On the other hand, the laboratory workers, dealing with atoms and electrons from day to day, could not fail to be more impressed with the discontinuous phenomena and the beautiful way these could be explained by the quantum. Such men would cheerfully accept the Bohr orbits as a complete explanation of the hydrogen spectrum, and certainly in many cases would be actually ignorant of the difficulty, the monstrous absurdity, of supposing that a sharp jump from one orbit to another could be responsible for a train of waves shown by the spectroscope to be lasting for quite a long time. So the majority of rational beings behaved in the natural human way of managing to forget all the disagreeable facts. But not every one, for there were Bohr and other leaders who recognized the difficulties on both sides but could still maintain an attitude of balance and could believe that from somewhere there would come a higher synthesis by which everything would be fitted together.

As time went on the quantum got obviously stronger and stronger, and began to invade more fields. The nuclear atom in the hands of Bohr showed itself capable of giving all the broad details of the periodic table of chemistry, still with nothing done to meet the awful difficulties of optical theory. But about 1925, guided by the correspondence principle, things were moving towards a tentative theory of the refractive index, and it was this that finally suggested the break in the contradictions. Acting on a hint given by the theory of refraction, Heisenberg was led to the suggestion that the contradictions of atomic theory would disappear if one adopted the idea of non-commutative algebra in dealing with the motions of electrons in an atom. Then the floodgates broke and the whole new quantum theory burst forth. It would of course be an incomplete account of it not to mention the quite different approach made independently by de Broglie and Schrödinger. If we are to trace this to its origin we must go back a century to Hamilton, for it was his work in geometrical optics which showed how a wave of short wave-length could be treated as a ray. It was de Broglie who worked out the modern analogies, but it was Schrödinger who succeeded in giving its full form, and by the invention of the *wave-function* placed in the hands of the mathematicians the most powerful of weapons for the technical discussion of atomic problems.

At first the work was of a formal kind, obviously right, and a complete synthesis of the rival doctrines of particle and wave mechanics, but there is a very interesting point that has gradually emerged in connection with the discovery. In his first paper Heisenberg laid great stress on the idea of building theory only on directly observable quantities. It is not very clear how the distinction was drawn. The electron's orbit is certainly not observable, but is it less so than the electric force which is the amplitude in the light-wave emitted by the atom? It has seemed to me that it was not this idea of using the observable that was the merit of his work, but rather the contrary—the capacity for carrying through a formal mathematical analogy without ever asking what it all meant in terms of observable things. However that may be, it was only a year later that he remedied the defect by making a picture of his process by means of the uncertainty principle. I may remind you that the uncertainty principle asserts that it is impossible simultaneously to measure the position and velocity of any body, because the measurement of either inevitably produces a change of indeterminate amount in the other. The subject has been so often discussed that I am not going into it now, but as it concerns the center of my argument, I want to emphasize its negative side, which as I think is much the most important. In this rôle the uncertainty principle is to be regarded as the argument used to defeat the old-fashioned physicist who claims that there is at any rate ideally no limit to the accuracy with which both position and velocity can be simultaneously measured. He has to admit the correctness of experiments such as the Compton effect, and we show him that by his own admission he will be defeated. On the positive side the principle is not so useful, because once we have seen the reason for the failure of classical ideas, we had better take advantage of the full technique of the quantum mechanics. Here my point is that the uncertainty principle showed up a fallacy in the old arguments about causality, and it was a fallacy about which we were so unconscious that we did not even know we were making it. It is now easy to see that there was nothing wrong with the old inference that if I know all about the present I can forecast the future exactly; the trouble was the impossibility of knowing the present. Once this is seen the whole argument becomes obvious, but nobody saw it until Heisenberg. We had somehow to avoid the compulsory causality of the old mechanics, and there seemed no loophole allowing us to do so until the uncertainty principle. Knowing what we now know we may ask why no one discovered the loophole by applying a strict analysis, for example, by the use of symbolic logic. Such an analysis would presumably have revealed the fault, but the trouble is that it would also have revealed other unwarranted assumptions which we have made but which we do not in the least want to doubt, so that it would not really have helped in pinning down the exact point of error. It is invention, not criticism, that leads to the advance of knowledge.

Following up the later history of the subject, the success of Heisenberg in exploiting the idea of observables for atoms seemed to repeat the brilliant success of Einstein twenty years earlier in using the same idea over relativity. It seemed to imply that what was wanted in physics was to free ourselves of all abstractions and only make theories about real things. There grew up a great cult of doubting the reality of unobserved things, and then a curious thing was found; the charm did not work again, and only a few minor things have come out of it. The work of the new quantum theory has in fact run most surprisingly in the opposite direction. The technique is largely concerned with wave-functions, which are quantities much more abstract than anything in classical mechanics. There is certainly nothing observable, or even picturable, about waves propagating themselves in many-dimensional space with absolutely unknowable phase, and with intensity controlled by the curious extraneous rule of normalization. Largely by the use of these wave-functions the whole of atomic physics has been reduced to order, and so has molecular physics, except that it yields problems in which so many electrons are interacting that a full discussion is not feasible. doctrine of theorizing only about observables was not really a useful doctrine; it merely provided a germinating idea. In fact, we may well ask what an observable is, and if we go at all beyond direct sensations, which as physicists we certainly intend to do, the answer becomes perfectly indefinite. This opinion I heard admirably expressed a few years ago by the late Professor Ehrenfest. It was in a physics meeting in Copenhagen and some one was proposing a way out of certain difficulties which involved, as he maintained, a reversion to the cult of the observable. Professor Ehrenfest said: "To believe that one can make physical theories without metaphysics and without unobservable quantities, that is one of the diseases of childhood—*das ist eine kinderkrankheit.*"

I have dwelt at some length on the history of the quantum theory because I think it serves as an analogy to the deeper question of what is wrong with the old logical processes. Just as we used to feel the all-pervading compulsive force of causality, so we feel the all-pervading force of pure logic. Just as we felt that classical mechanics provided no room for anything beyond itself, so we feel that the old logic is the only admissible kind of reasoning. We know that certain things led to the old quantum theory and obstinately refused to fit into mechanics, and we know that the principle of probability can cover many things outside the old logic. Many men tried to force the quantum theory into the classical system, and many are still trying to bring probability within the fold of the old logic. I do *not* believe it can be done. This is not the occasion, nor have I the capacity, for a deep argument on the place of probability in logic, but one of the most convincing ways of seeing it may be found in the consideration of another branch of physical theory, the kinetic theory of gases.

In the early days of kinetic theory the central problem was the law of distribution of velocities of the molecules and attempts were made to prove the law absolutely from dynamics, but the process always failed. Maxwell made the assumption that with the lapse of time a system of molecules would pass through all possible phases. There are technical difficulties in the discussion of this assumption which have never been overcome, and it is quite uncertain if it is even true. Indeed Kelvin, who disliked the whole kinetic theory, argued with some force that the only examples any one could give contradicted the principle—for example, the motion of the planets. The greatest contribution to the subject was that of Gibbs, who recognized that there had to be a big assumption somewhere and made it quite frankly and without attempt at justification. The works of Gibbs are not easy reading; in both his great works he attends to every detail with a particularity that is really rather tedious, whereas his basic ideas are thrown at the reader almost without explanation. The idea of a canonical ensemble is a really beautiful idea once you understand it, but where does it come from? An ensemble is an idea which will be unfamiliar to many, so I had better explain it. We want to know something about the behavior of a complicated system composed of a great many parts; say we want to know the pressure of the gas in some vessel. If we tried to attack the question by pure mechanics, we should be faced with an enormous number of mechanical equations for the motions of the molecules, and even if these could be solved the solution would be of no use, because it would depend on the initial positions and velocities of the molecules, and these we should not know. Instead of trying this impossible and useless task, Gibbs considers a very large number of possible states of motion of the set of molecules, which have some character in common, such as their total energy, but which are otherwise unrelated. Though each specimen of the motions is quite independent of all the others, he looks at them all together; this explains the word *ensemble*—I do not know why he had to take a French word—and makes the assumption that the pressure of the gas is correctly given by the average of all the specimens. The actual gas in the vessel at any instant is one of the specimens; in its motion it passes into configurations corresponding to others, but only after a fantastically long time would it go through even a perceptible fraction of the whole ensemble. Gibbs is assuming that the behavior of the actual gas will be determined by the average of the uncountable millions of specimens in the ensemble. Almost at the start one finds oneself presented with the ensemble with hardly an attempt to explain where it comes from or why it is right, and the beginner is usually troubled by the fact that, though the subject is obviously mechanical, all the mechanics he laboriously learned in his youth seem to have faded into comparative unimportance. There are various kinds of ensemble, the chief of which is the canonical, corresponding to all the possible motions of the gas which would have the same temperature. Later, almost as a concession to human frailty, Gibbs introduces the micro-canonical ensemble, composed of much fewer specimens becausee they all have exactly the same energy. This is usually welcomed by the beginner because it seems closer to his familiar mechanics, but with more experience he will realize that the gap is still so great that he is really no better off, and he may as well accept the more general idea at once.

With the old mechanics all this involved ideas which for many readers were distinctly hard to accept. The principle of probability, embodied in the averaging over the ensemble, was frankly laid on top of the logical principles of Newtonian mechanics, and to any one believing that probability would ultimately be brought down to the old logic the association was most repellent. But we can now see that Gibbs was a prophet far ahead of his time—and indeed, to be frank, far ahead of his own knowledge—for the new mechanics accommodates the ensemble very much more easily than did the old. The new mechanics has shown us that it is impossible to know how the individual molecules are moving, because when one undertakes an experiment to see, that experiment automatically alters the condition of the gas and so fails to tell what was wanted, the state of the molecules without the experiment. In the old days one used to feel that the validity of Gibbs's idea would be spoiled by some skilful experimenter who would really observe the motions of the individual molecules and would therefore rule out the legitimacy of averaging over the *whole* ensemble, but we now know that there is no danger of this. The real gas in the vessel is not merely one specimen of the ensemble, unrecognizable only because of our clumsiness; it is itself the whole of the ensemble. We used to think of the gas as *either* in the state A, *or* in the state B, *or* in C, but according to the new physics we have to think of it as in *all* the states A *and* B *and* C. The distinction is typical of the change we must make in our habits of thought, and most of us resist this change strongly, for we find we can hardly help asking: "But which state was it really in?" As I have said, we used to be ashamed of ignorance, but we must now realize that *this* ignorance is one of the things that makes the world possible. The principle of probability, which used to be loosely superposed on the old logical principle, is now with the new mechanics fully united with it in a higher synthesis.

Before leaving Gibbs I would like to refer to one thing in his book, where I think he has not even yet come into his own. He considers various types of ensemble of increasing generality. In the micro-canonical the members all have the same energy. Now we never know the exact energy of the gas in a vessel, so that a better idea is the wider one of a gas at a given temperature, which therefore has a certain range of admissible energies. This is represented by Gibbs's canonical ensemble, and it is the main one that he uses. In both these the number of atoms in the ensemble is constant. But in the last chapter of his book Gibbs introduces a still wider ensemble. He calls the ones with a constant number of atoms *petits ensembles*, which I shall translate as petty ensembles, and regards them as parts of a grand ensemble in which the total number of atoms is not fixed. He uses the idea to some extent in connection with semi-permeable membranes, but on the whole does not get far with it. As in much of Gibbs's work, it is the idea itself, rather than what he does with it, that is important. This idea of the grand ensemble is not yet incorporated in the new physics. In the quantum theory we take a number of electrons and nuclei and, allowing for their interactions, we construct something that is practically the canonical ensemble. But we take fixed numbers of them—this is partly reflected in the technical process of using normalized wave-functions. Now in an experiment dealing with a large number of particles we are never really sure exactly how many there are, and to assume this number is much like assuming a constant energy for them. If the canonical ensemble is a better idea than the micro-canonical, then the grand ensemble is superior to the petty ensemble. In the new mechanics nobody has yet succeeded in making anything of it, or has made any proposal how to do so, but I will venture to forecast that when some of our present difficulties in the quantum theory are cleared up, it will be found that we shall be using the grand ensemble with its indefinite number of atoms.

Reverting to my main theme, what is the moral of all this? It is that the new physics has definitely shown that nature has no sharp edges, and if there is a slight fuzziness inherent in absolutely all the facts of the world, then we must be wrong if we attempt to draw a picture in hard outline. In the old days it looked as if the world had hard outlines, and the old logic was the appropriate machinery for its discussion. Things went wrong when it was found necessary to call in the help of the principle of probability; this appeared first as an alien, but there was hope in the old days that the alien might be naturalized. It has resisted the process and we now recognize that it can not be assimilated, because it provides the necessary step to a wider reason, that of the new fuzzy world of the quantum theory, a world which is not contained in the old. How far it will be possible to make a full synthesis of the new and the old I do not know, but I like to think there is something in my analogy from the history of the quantum theory, and to suppose that we are still in the condition corresponding to the old quantum theory, and that some day a real synthesis will be made like that of the new quantum theory, so that there will be only one thing in the world that has not indefinite outlines, and that will be a new reformed principle of reasoning.

I may fitly conclude this part of my subject by returning to the point from which I started. As an example of what the ordinary man regards as correct reasoning I quoted some words of Sherlock Holmes. I must now confess that I was not quite sincere in my quotation; the impression I gave was the impression the reader carries away, but on examining the text I was interested to find that the great detective had himself arrived at the ideas I have been putting forward. In the sentence before he said "No, no; I never guess. It is a shocking habit destructive of the logical faculty," he had said: "I could only say what was the balance of probability—I did not expect to be at all accurate." The master-mind uses the word logic in its modern sense.

There may be a feeling among some that the very general suggestions I have been making are open to every sort of criticism. Perhaps they are right; as I have said, it is part of my doctrine that the details of a physicist's philosophy do not matter much. But whether it is wrong or right, my next point is one on which I do very much hope that there may be a consensus of agreement. This is that the subject of probability ought to play an enormously greater part in our mathematical-physical education. I do not merely mean that every one should attend a course on the subject at the university, but that it should be made to permeate the whole of the mathematical and scientific teaching not only at the university but also at school. To the best of my recollection in my own education I first met the subject of probability at about the age of thirteen in connection with problems of drawing black and white balls out of bags, and my next encounter was not till the age of twenty-three, when I read a book—I think it was on the advice of Rutherford—on the kinetic theory of gases. Things are better now, but mathematicians are still so interested in the study of rigorous proof that all the emphasis goes against the study of probability.

Its elements should be part of a general education also, as may be illustrated by an example. Every month the Ministry of Transport publishes a report giving the number of fatal road accidents. Whenever the number goes up there is an outcry against the motorists, and whenever down, of congratulation for the increased efficiency of the police. No journalist ever seems to consider what should be the natural fluctuations of this number. A statistician answers at once that the natural fluctuation will be the square root of the total number, and apart from obvious seasonal effects that is in fact about what the accidents show; the number is roughly 500 ± 25. The proof of this does not call for any difficult mathematics, neither the error function nor even Stirling's formula, but can be done completely by the simple use of the binomial theorem. There is no mathematical difficulty that should trouble a clever boy of 15; it is only the train of thought that is unfamiliar, and it is just this unfamiliarity that is the fault of our education. The ideas and processes connected with the inaccuracy of all physical quantities are much easier to understand than many ideas that a boy has to acquire in the course of his studies; it is only that at present they are not taught, and so when met they are found difficult.

This is not the place to describe a revised scheme of education. I would only say that it is not special new courses that are needed, but rather a change in the spirit of our old courses. When a boy learns about the weighing machine, emphasize its sensitivity and consider the length of time that must be taken for the weighing. When he has a problem on projectiles, make him consider the zone of danger and not merely the point of fall. At a rather higher level, but still I should hope at school, introduce the idea of a distribution law; for example, in doing central orbits work out Rutherford's law of scattering. Calculate the fluctuations of density of a gas, or the groupings in time of the scintillations of α-particles. All these things ought to be examples of a familiar train of thought, and not merely a highly specialized side branch of mathematics first met at the university. It is the incorporation of probability in the other subjects on which I want to insist, but there will of course remain some higher aspects—things like least squares or significance tests—which are still to be treated in separate university courses. Even these I should hope would come to be recognized as subjects of central interest and not, as they are at present, relegated to a remote corner of specialized study.

If these reforms are carried out I shall hope that generations will grow up which have a facility that few of us at present possess in thinking about the world in the way which the quantum theory has shown to be the true one. The inaccuracies and uncertainties of the world will be recognized as one of its essential features. Inaccuracy in the world will not be associated with inaccuracy of thought, and the result will be not only a more sensible view about the things of ordinary life, but ultimately, as I hope, a fuller and better understanding of the basis of natural philosophy.

SCIENTIFIC EVENTS

NATIONAL PARKS

PRESIDENT ROOSEVELT has approved a recent act of Congress, marking an important step towards the final establishment of the proposed Isle Royale National Park in the State of Michigan. This act provides that all lands purchased by the Federal Government for conservation or forestation purposes within the authorized park boundaries, with funds heretofore allocated and made available by executive order, or otherwise, shall be made a part of the park as fully as if originally acquired for that purpose.

The establishment of the Isle Royale National Park was authorized by the act of Congress approved on March 3, 1931. Isle Royale, the largest island in Lake Superior, is rich in wildlife and is famous for its copper mines worked by Indians before the advent of white men. It is situated just within the international boundary separating Canada and the United States, being 50 miles northwest of Keweenaw Point, Michigan, and 20 miles southeast of the nearest Canadian mainland at Thunder Cape. Isle Royale measures 44 miles in length and 9 miles in width, including an area of 205 square miles. To date, 102,000 acres of land have been acquired under the executive order, leaving approximately 19,000 acres under contract to be purchased or in condemnation. The State of Michigan, which has appropriated $100,000 toward the acquisition of private rights on the island, must also cede exclusive jurisdiction to the United States over the lands acquired directly by the Federal Government before the park will be fully established.

Two days before his term as Chief Executive expired on March 4, 1909, Theodore Roosevelt by executive order established the Mount Olympus National Monument. An act was passed during the closing hours of the last session of Congress creating the Olympic National Park with the Mount Olympus National Monument as a nucleus. It provides for the immediate inclusion of 634,000 acres, nearly twice the area of the Mount Olympus National Monument, and in addition authorizes the President to add to this acreage lands from the Olympic National Forest and any lands that may be acquired by gift or purchase up to 898,292 acres. The region comprising the park is one of rugged ice-capped peaks and dark but vividly green "rain forests" of giant moss-festooned spruce and fir; of lake-studded flowering meadows forming natural gardens. Through its deep canyons streams fed by the waters of melting glaciers above find their outlet in the Pacific.

Purchase by the Federal Government of the last remaining land needed to complete the Great Smoky Mountains National Park in the wilderness of North Carolina and Tennessee has been announced. The act provides an appropriation for the National Park Service with which it will be possible to acquire 26,000 acres of land in Tennessee. All but the relatively small amount of land remaining to be bought gradually has been acquired since 1926 by the states with private donations and with state and federal funds. Private funds were matched, dollar for dollar, up to $5,000,000 by the Rockefeller Foundation as a memorial to Laura Spelman Rockefeller, mother of John D. Rockefeller, Jr. The Great Smoky Mountains National Park area so far acquired has been under the jurisdiction of the National Park Service since 1930. With the money now available, the final steps can be taken toward completion and formal dedication of the park. To date title to 410,000 acres within the prescribed boundary is in the name of the United States, of which North Carolina purchased and gave title to approximately 184,752 acres, and Tennessee 165,921 acres. Also 59,394 acres were purchased with emergency funds authorized by executive order, at a cost of about one and a half million dollars, leaving the approximately 26,000 acres in Tennessee, the purchase of which now is possible.

FIELD WORK OF THE PHILADELPHIA ACADEMY OF NATURAL SCIENCES

Eighteen expeditions and field projects have been carried on for the Philadelphia Academy of Natural Sciences during 1938, which include the following:

Jacques Francine, of Philadelphia, lived four months during the late winter and spring with a party of Swampy Cree Indians in the inaccessible wilderness of the Labrador Peninsula collecting mammals. He and Paul Millard, a French trapper, were flown by airplane some five hundred miles north of Quebec in the middle of last March. Arriving at the Crees' encampment, they shared with them the hardships of short rations and 40 below zero blizzards until the spring thaws made it possible for the group to migrate by canoe down the unmapped Kowashamiska River, about the size of the Connecticut River, south to the Hudson's Bay Post where the Indian furs were traded.

In Mexico, R. R. M. Carpenter, trustee of the academy, collected birds and mammals during March with Harold T. Green of the staff, and H. Radclyffe Roberts is collecting grasshoppers in the highlands north of Mexico City under the auspices of the academy and of the American Philosophical Society.

In the West Indies James Bond continued his survey of bird life and distribution, and at Madagascar, off the coast of Africa, Charles Lamberton is making a collection of insects.

Dr. Edgar B. Howard is carrying on his field researches for early man in North America, both in Florida and at Nebraska. He is accompanied by Malcolm Lloyd and Edward Page, Jr. Dr. Francis W. Pennell, assisted by a grant of the American Philosophical Society, is gathering botanical material in Utah and Colorado; and in Florida John Cadbury made a collection of insects during the month of March.

From Dutch New Guinea, one of the last frontiers of undisturbed wild life, Dillon Ripley returned with a large collection of zoological material, including birds, shells, plants and fish which he collected while a member of the Denison-Crockett Expedition to the southern Pacific.

The R. M. de Schauensee Zoological Survey of Siam is continuing its fourth year of research and the collecting of fish, birds and mammals, and Charles Primrose is doing similar work in India. An expedition sponsored by the academy and the Peabody Museum of Harvard College is seeking traces of early man in northern India, Java and the Philippines. During the past six months George Vanderbilt has continued making collections for the fish department, while he has been at Hawaii and the adjacent islands. In South America, M. A. Carriker, Jr., and Gordon Howes continued their study of bird migrations and distribution in Bolivia, and to the north in Columbia, Kiell von Sneidern is collecting birds.

THE FOURTH INTERNATIONAL CONGRESS OF COMPARATIVE PATHOLOGY

The fourth International Congress of Comparative Pathology will meet in Rome, from May 15 to 20, 1939, under the official auspices of the Italian Government, with headquarters at the National Council for Researches, Piazzale delle Scienze.

Professor Pietro Rondoni, member of the Italian Academy and director of the Cancer Institute and of the Institute of General Pathology of the University of Milan, is president of the congress, and Professor Vittorio Zavagli, director of the Experimental Station for Animal Prophylactics, Rome, is secretary. The vice-presidents are: Senior Professor Nicola Pende, director of the Institute of Pathology and Medical Methodology of the Royal University, Rome; Professor Alessandro Lanfranchi, director of the Institute of Pathology and Veterinary Medical Clinic of the Royal University of Bologna; Professor Lionello Petri, director of the Institute of Phytopathology, Ministry of Agriculture, Rome, and Dr. Ugo Frascherelli, general secretary of the National Council for Researches, Rome, is the general secretary.

All meetings will be held at the Royal University and at the Institute for Public Health. The official languages will be Italian, English, French, German and Spanish.

The congress, which is of a purely scientific nature, has as its object the comparative study of pathology in human beings, animals and plants, bearing particularly upon diseases common to several groups of organisms and upon general organic reactions, viewing all biological as well as economic and social correlations. It will meet in three sections: Human Medicine, Veterinary Medicine and Phytopathology. There will be reports on ultra virus diseases, heredity in pathology, the function of the associated antigenes and regressive processes in plants.

In order to render more complete and more interesting the study of the various problems and to bring about closer mutual relations among the students of related sciences, the main subjects which are on the agenda will be reported on and discussed before an assembly of all the sections.

The papers sent to the various sections must be related to the main subjects and be as concise as possible. A summary of about one hundred words must reach the secretariat not later than March 31, 1939. The organizing committee will make a final decision in regard to the acceptance of papers. It is provided that it may accept papers bearing upon other subjects, if they are of particular importance and originality.

THE INTERNATIONAL GEOLOGICAL CONGRESS

THE eighteenth session of the International Geological Congress will be held in London from July 31 to August 8, 1940.

At a special meeting recently called by the Geological Society of London and attended by representatives of kindred societies, public bodies and personal donors to the congress funds, it was decided to entrust the preparation and organization of the congress to a general organizing committee. It was also decided to vest the executive authority of the general organizing committee in an executive committee and to recommend to the bureau of the congress that the officers of the general organizing and executive committees be the officers of the congress. These committees were unanimously elected. It was further agreed that the power to add to the membership of the general organizing committee and the executive committee be vested in the council of the Geological Society of London.

Officers of the general organizing committee are:

Honorary President

Sir William Bragg, president of the Royal Society.

Honorary Members

The Right Honorable The Lord President of His Majesty's Most Honorable Privy Council.
The Lord Lieutenant of the County of London.
The Right Honorable The Lord Mayor of London.
The Chairman of the London County Council.
The Chancellor of the University of Cambridge.
The Chancellor of the University of London.
The Chancellor of the University of Oxford.
The Chancellor of the University of St. Andrews.
The President of the Royal Society.
The President of the Royal Society of Edinburgh.
The Director-General of the Ordnance Survey.
The Hydrographer of the Navy.
The Director of the British Museum (Natural History).
The Director of the Royal Botanical Gardens, Kew.
The Right Honorable Viscount Bearsted, chairman of the Shell Transport and Trading Co.
The Right Honorable Lord Cadman of Silverdale, chairman of the Anglo-Iranian Oil Co.
Sir John S. Flett, formerly director of the Geological Survey of Great Britain.
Dr. Alfred Harker, St. John's College, Cambridge.
Sir Thomas Holland, principal and vice-chancellor of the University of Edinburgh.
Sir Albert Seward, South Kensington.
R. I. Watson, Esq., director of the Burmah Oil Co.
Professor W. W. Watts, emeritus professor of geology in the Imperial College of Science and Technology.
Sir Arthur Smith Woodward, Haywards Heath, Sussex.

Officers

Vice-presidents: the president of the Geological Society of London and the director of the Geological Survey of Great Britain.
General Secretaries: Dr. W. F. P. McLintock, deputy director of the Geological Survey of Great Britain, and Professor W. B. R. King, University College, London.
Treasurer: F. N. Ashcroft, London.

No professional title is required from those registering as members of the congress. Nevertheless, the excursions organized before and after the session will be more especially reserved for the members who are geologists, geographers and mining engineers, and for others who devote themselves to the study or practice of some branch of geology.

Proposed subjects for discussion are:

Magnetic Differentiation.
Metasomatic Processes in Metamorphism.
Caledonids in Northwest Europe.
Rhythm in Sedimentation.
The Geology of Iron-Ore Deposits.
The Geology of Coal Seams.
The Geology of Petroleum.
The Geology of Sea and Ocean Floors.
The Stratigraphical Limits of the Ordovician System.
The Pliocene-Pleistocene Boundary.
The Distribution of Early Vertebrates.
Faunal Facies and Zonal Correlation.
Earth Movements and Evolution.
The Geological Results of Applied Geophysics.

An elaborate program of excursions to be taken before, during and after the congress has been arranged. Requests for further information should be addressed to the General Secretaries, International Geological Congress, Geological Survey and Museum, Exhibition Road, South Kensington, London, S.W. 7. The address for foreign telegrams and cables is Incongeol, London.

SYMPOSIA AT THE MILWAUKEE MEETING OF THE AMERICAN CHEMICAL SOCIETY

SYMPOSIA at the meeting of the American Chemical Society, meeting in Milwaukee from September 5 to 9, are reported in *Industrial and Engineering Chemistry.*

The Division of Agricultural and Food Chemistry has arranged a symposium on the Industrial Utilization of Agricultural Products, in which the Division of Biological Chemistry and possibly the Division of Industrial and Engineering Chemistry will cooperate. In addition a joint symposium on vitamins and another on patents will be sponsored by the division in cooperation with the Divisions of Biological Chemistry and of Medicinal Chemistry. These three divisions have arranged vitamin symposia for the past seven meetings.

The Division of Colloid Chemistry, together with the Division of Physical and Inorganic Chemistry, has arranged a symposium on the Physical Chemistry of the Proteins. Invitations to participate have been accepted by Drs. Langmuir, Cohn, Kirkwood, MacInnes, Eyring, Stanley, Heidelberger, Abramson and Koets. In addition to the symposium on proteins, the Division of Physical and Inorganic Chemistry is sponsoring symposia on the determination of traces—which members of the microchemical division are invited to attend—on liquid ammonia and on nuclear chemistry.

The Division of Industrial and Engineering Chemistry will take part in three symposia as follows: Unit Processes, organized by R. Norris Shreve; Surface Active Agents, with F. E. Bartell as chairman; and Electrical Insulating Materials, organized by the Subcommittee on Chemistry, Conference on Electrical Insulation, National Research Council, with F. L. Miller as chairman.

The Division of Organic Chemistry will cooperate with the Division of Sugar Chemistry and Technology in a Symposium on Nomenclature of the Sugars and Their Derivatives and probably with the Division of Physical and Inorganic Chemistry in the symposium on Reactions in Liquid Ammonia.

THE ANNUAL SUMMER MEETING OF THE AMERICAN MATHEMATICAL SOCIETY

THE forty-fourth annual summer meeting of the American Mathematical Society, to be held from September 6 to 9, at Columbia University, New York City, will be devoted in large part to the celebration of the fiftieth anniversary of the founding of the society. While there will be ten sectional meetings for the presentation of the usual short papers embodying the results of recent mathematical research, the main scientific feature will be the program of invited addresses designed to review some part of the progress of mathematics during the half century of the life of the society. Speakers and their subjects are as follows: R. C. Archibald, Brown University, "History of the American Mathematical Society, 1888–1938"; G. D. Birkhoff, Harvard University, "Fifty Years of American Mathematics"; E. T. Bell, California Institute of Technology, "Fifty Years of Algebra in America, 1888–1938"; G. C. Evans, University of California at Los Angeles, "Dirichlet Problems"; E. J. McShane, University of Virginia, "Recent Developments in the Calculus of Variations"; J. F. Ritt, Columbia University, "Algebraic Aspects of the Theory of Differential Equations"; J. L. Synge, University of Toronto, "Hydrodynamical Stability"; T. Y. Thomas, Princeton University, "Recent Trends in Geometry"; Norbert Wiener, Massachusetts Institute of Technology, "The Historical Background of Harmonic Analysis," and R. L. Wilder, University of Michigan, "The Sphere in Topology." The society is publishing a volume containing these addresses, except Professor Archibald's, under the title of "Semicentennial Addresses." It is publishing also a history of the society by Professor Archibald.

The opening session of the jubilee celebration will be marked by the presence of delegates from over fifty scientific and learned societies, including approximately thirty foreign mathematical societies, those American and Canadian scientific societies whose interests are most closely related to mathematics, and such organizations of general scientific interests as the National Research Council, the National Academy of Sciences and the American Association for the Advancement of Science. The address at this meeting will be delivered by President Nicholas Murray Butler, of Columbia University.

The committee on the semi-centennial celebration is attempting to arrange a meeting distinguished not only for its scientific program, but marked also by a birthday spirit of good fellowship. A particularly festive occasion will be the "Birthday" dinner, at which the society will honor its principal founder and first secretary, Professor Emeritus Thomas Scott Fiske, of Columbia University, who more than any other one person was responsible for the organization of the New York Mathematical Society at a meeting of six persons on November 24, 1888. It was this organization which six years later changed its name to the American Mathematical Society.

In connection with the meeting, there will be an exhibit of mathematical manuscripts, books, models and instruments, arranged by Professor David Eugene Smith.

SCIENTIFIC NOTES AND NEWS

A MEETING of the representatives of the American and British Associations for the Advancement of Science was planned prior to the Cambridge meeting of the British Association at Lord Rayleigh's Chelmsford estate. A discussion was proposed concerning cooperation between the two associations, and perhaps with the corresponding associations of other nations, on international scientific relations, more especially problems arising from the impact of science on the social order. The American delegates included Professor George D. Birkhoff, retiring president of the American Association, and Dr. F. R. Moulton, permanent secretary. In addition to Lord Rayleigh, president, the British Association representatives included Dr. J. J. R. Howerth, secretary of the British Association, and Sir Richard Gregory, editor of *Nature*.

AMERICANS on the program of the meeting of the British Association for the Advancement of Science now meeting at Cambridge include: Dr. Harlow Shapley, Paine professor of practical astronomy and director of the Harvard College Observatory, "Metagalactic Gradients and the Expanding Universe Hypothesis"; Dr. R. W. Wood, professor of experimental physics at the Johns Hopkins University, "Diffraction Gratings for Astrophysical Purposes"; Dr. J. H. Van Vleck, professor of physics at Harvard University, "The Molecular Field and the Determination of Very Low Temperatures," and Dr. George D. Birkhoff, Perkins professor of mathematics and dean of the Faculty of Arts and Sciences of Harvard University, "Analytic Deformations."

THE honorary degree of doctor of science was conferred by the University of Oxford in July on Dr. Harvey Cushing, Sterling professor of neurology emeritus of Yale University and Moseley professor of surgery emeritus at the Harvard Medical School. Before the ceremony a luncheon was given in his honor by the vice-chancellor of the university.

IN addition to the election as foreign associates of the Paris Academy of Sciences of Professor T. H. Morgan and Sir William Bragg, already announced in SCIENCE, *Nature* reports the election of Professor T. Levi-Civita, emeritus professor of mechanics in the University of Padua.

DELEGATES attending the recent conference of the International Medical Congress for Psychotherapy, which met at Oxford during the last week in July, paid tribute to Professor Freud, who recently left Austria and has taken up his residence in London. In a telegram sent to him the delegates said: "We recognize our indebtedness to you for your brilliant contributions to psychological medicine, and wish you health, happiness and tranquility in your new surroundings in England."

DR. ARTHUR C. CHRISTIE, surgeon, formerly president of the Medical Society of the District of Columbia, has received the second Dr. Frank E. Gibson Award in recognition "of meritorious contributions to medical science." The prize is presented by the Washington Medical and Surgical Society and is named in honor of Dr. Gibson, permanent treasurer of the society.

DR. HERBERT F. PRYTHERCH, director of the Beaufort, N. C., laboratory of the U. S. Bureau of Fisheries, has been awarded the gold medal of the North Carolina Academy of Science for his paper on "The Life Cycle of a Sporozoan Parasite of the Oyster," presented at the 1938 meeting of the society in Raleigh.

THE Keith Prize of the Royal Society of Edinburgh has been awarded to Dr. H. S. Ruse, professor of pure and applied mathematics at University College, Southampton, for his paper "On the Geometry of Dirac's Equations and their Expression in Tensor Form" and for other papers. The Neill Prize has been awarded to Professor William J. Hamilton, St. Bartholomew's Hospital Medical College, for his contributions to the embryology of the ferret and other work.

Nature reports that the Gold Medal of the British Institution of Mining and Metallurgy has been awarded to Professor S. J. Truscott, "in recognition of his services in the advancement of the science and practice of mining and metallurgy, with special reference to his services in technological education." The Consolidated Gold Fields of South Africa, Ltd. Gold Medal has been awarded to Professor H. V. A. Briscoe, "in recognition of his researches on the sampling and properties of industrial dusts"; the Consolidated Gold Fields of South Africa, Ltd. Premium of forty guineas has been awarded conjointly to Dr. Janet W. Matthews, P. F. Holt and Miss Phyllis M. Sanderson, "in recognition of their work, in association with Professor H. V. A. Briscoe, on the sampling and properties in industrial dusts."

PROFESSOR THOMAS BENJAMIN DAVIE, professor of pathology in the University of Bristol, has been appointed to the George Holt chair of pathology from October 1, in succession to Professor J. H. Dible, now professor of pathology in the Post-graduate Medical School, London.

DR. CLOVIS VINCENT, head of a private clinic for brain surgery in Paris, has been appointed to a newly established chair of brain surgery in the School of Medicine of the University of Paris.

DR. T. G. DELBRIDGE, manager of the Research and Development Department of the Atlantic Refining Company, Philadelphia, has been elected president of the American Society for Testing Materials. W. M. Barr, chief chemical and metallurgical engineer of the Union Pacific Railroad Company, has been elected vice-president.

DR. GUSTAVUS AUGUST EISEN, formerly curator of the California Academy of Sciences, later connected with the U. S. Department of Agriculture, celebrated his ninety-first birthday on August 2.

Dr. Francois A. Gilfillan, professor of pharmacy in the School of Pharmacy of the Oregon State College, has been appointed dean of science at the college. He succeeds Dr. E. L. Packard, who has become dean of general research for the state system of higher education and has been made director of the Institute of Marine Biology. Dr. Packard will also continue as head of the department of geology at the college.

Dr. J. L. Deen, associate professor of silviculture at the Pennsylvania State College, and N. A. Christensen, of the California Institute of Technology, have been appointed deans of the schools of forestry and engineering, respectively, of the Colorado State College.

At the University of Maryland, Fred H. Leinbach has been appointed professor of animal husbandry to succeed K. A. Clark, who recently accepted the managership of Oldfields Farm at Galena. James B. Outhouse has been made instructor and assistant in the department of animal husbandry. Dr. Kenneth L. Turk, assistant professor in the extension department of animal husbandry at Cornell University, has been appointed professor of dairy husbandry, to succeed Professor L. W. Ingham, who recently accepted a position at the National Farm School at Doylestown, Pa.

Dr. Clifford S. Leonard, for the past ten years a director of research in the pharmaceutical industry, has been appointed assistant professor of pharmacology in the College of Medicine of the University of Vermont.

Horace J. Andrews, of the U. S. Forest Service, who has been in charge of a survey of the forest resources of the Pacific Northwest, has been appointed Charles Lathrop Pack professor of wild land utilization in the School of Forestry and Conservation of the University of Michigan. The work will be conducted as an expansion of the activities of the George Willis Pack Forestry Foundation directed by Professor W. F. Ramsdell and will be closely associated with related activities in the university, particularly in the Horace H. Rackham School of Graduate Studies.

Dr. Ralph Howard Fowler, fellow of Trinity College, has been reelected to the John Humphrey Plummer professorship of mathematical physics at the University of Cambridge. The London *Times* writes that Professor Fowler resigned from this chair on his acceptance of the directorship of the National Physical Laboratory on the resignation of Professor W. L. Bragg, but that he had been advised to withdraw his acceptance of this post for reasons of health, and signified willingness to be reelected as professor of mathematical physics.

Professor Morrough P. O'Brien, chairman of the department of mechanical engineering of the University of California, has been appointed a civilian member of the U. S. Beach Erosion Board.

James F. Wilson, associate professor of animal husbandry in the College of Agriculture at Davis of the University of California, has been made technical adviser to the committee on wool and other animal fibers of the American Standards Association.

Howard J. Kumin, who has been employed by the Division of Fishery Industries in the collection of fishery statistics during the past two years, has resigned from the bureau to become a member of the Bureau of Biological Survey.

The retirement is announced of Thomas Athol Joyce, since 1932 deputy keeper in charge of the subdepartment of ethnography of the British Museum. He was appointed in 1902 to the staff of the British Museum in the department of British and medieval antiquities and ethnography.

Dr. George L. Clark, professor of chemistry at the University of Illinois, has returned from a five months' leave of absence spent in Europe. He visited forty university and institutional laboratories conducting x-ray work in Italy, Switzerland, France, Germany, Austria, Czechoslovakia, Holland, Belgium, England and Scotland. He also represented the United States on the occasion of the celebration in Berlin of the eightieth birthday of Professor Max Planck.

William D. Campbell, field representative of the American Museum of Natural History, sailed on the Italian liner *Conte di Savoia* on August 6. He plans to make a six months' expedition to Africa to collect specimens to be added to groups in Carl Akeley African Hall at the museum. Members of the party will be Major W. V. D. Dickinson and Robert Kane, of the department of arts and preparations, who will assist in preservation of specimens and the preparation of backgrounds for the habitat groups.

A meeting of the American Society of Photogrammetry will be held in New York on September 8 and 9 at the headquarters of the American Geographical Society. Developments in commercial photographic equipment for map-making by aeroplane will be described and exhibited. All available floor space of the society will be taken up by special exhibits. Included among subjects to be discussed at the meeting are recent developments in papers, emulsions and lens filters, the ideal aeroplane for aerial survey purposes, photographic principles and their application in aerial photography.

The fiftieth anniversary of the founding of the Virginia Agricultural Experiment Station at the Virginia Polytechnic Institute, Blacksburg, Va., was celebrated on July 27 at a meeting held in conjunction with the Institute of Rural Affairs. The following program, presided over by Dr. John R. Hutcheson, director of the Virginia Agricultural Extension Division, was presented: "Some Results of Research at the Virginia Agricultural Experiment Station," by Director A. W. Drinkard, Jr.; "Some Results of Research at the Virginia Truck Experiment Station," by Director H. H. Zimmerley, and "The Place of Research in Planning for Rural Living," by Dean W. C. Coffey, of the University of Minnesota.

THE first program devoted to internationalism in science with the object of interpreting the dangers confronting freedom of scientific thought was broadcast by "Adventures in Science" over the Columbia network on August 12. Professor Edwin G. Conklin, of Princeton University, outlined specific situations that exist in which scientific men and the scientific method of approaching problems are being restricted by war and political attitudes. Appearing on the program with Professor Conklin was Dr. Paul B. Sears, formerly of the University of Oklahoma, who was recently appointed professor at Oberlin College. "Adventures in Science" is one of the adult education series, presented under the guidance of the Adult Education Board of the Columbia Broadcasting Company, of which Dr. Lyman Bryson, professor of education at Teachers College, Columbia University, is the chairman.

A CABLE from San Juan, Puerto Rico, to *The New York Times* states that according to a message received by Governor Blanton Winship from Frederick Coykendall, chairman of the board of trustees of Columbia University, the cooperation of the university with the University of Puerto Rico in the School of Tropical Medicine will be continued. This had been threatened by recent legislation eliminating the representation of Columbia University on the board of trustees. The message was in answer to one from Governor Winship giving assurance that the provisions of the bill eliminating Columbia University were an "error" which would be corrected.

DISCUSSION

THE VENOMOUS EFFECTS OF SOME ARIZONA SCORPIONS

DR. BAERG[1] states that the relative harmlessness of scorpions in the United States is generally known. It seems that this statement ought not to go unchallenged. More lives have been lost in Arizona from the sting of the scorpion than from the bite or sting of any other venomous arthropod or reptile at least during the nine-year period since 1929. For a period of six and one half years, beginning with 1929, there were recorded twenty-five deaths resulting from the sting of the scorpion and only ten deaths caused by the rattlesnake, gila monster and other poisonous animals. Most of the deaths due to scorpion sting have occurred in the southern part of the state, particularly in the Salt River Valley, and the victims have been children usually six years of age and under. The writer knows of one case in which an eight-year-old child succumbed to a scorpion sting.

In and around Mesa, Ariz., one commonly finds two species of scorpions, *i.e.*, *Vejovis spinigerus* (Wood) and *Centruroides sculpturatus* Ewing. A third species less commonly taken is *Hadrurus hirsutus* Wood, the giant hairy scorpion.[2]

The effect of the venom of these scorpions was tested on white rats (the Wistar strain) by permitting the scorpion to sting the experimental animal, usually in the hind foot where there is little or no fur and local reactions can more readily be observed. The sting of *H. hirsutus* caused a swelling in the region of the sting so that the toes were about twice their normal size. In the case of *V. spinigerus* a swelling likewise occurred, but it was not nearly so great as that produced by *H. hirsutus*. Other than the swelling none of the rats showed further effects from the venom of either of these two species. A slight nervousness was observed, but this was attributed to fright rather than to the venom. After about the first five minutes the rats did not even avoid walking with the swollen foot, but the foot was sensitive, more so than the others, when touched with forceps. Within two or three hours all signs of the sting had disappeared.

In the case of the third species, *C. sculpturatus*, no local swelling was noticeable, although the foot was favored, but the reaction seemed to be general and neuropathic. Death occurred within a period varying from ten minutes to one and one half hours. A general description of events from the time of the sting until death may be stated as follows. Within one or two minutes after the sting the rat shows signs of nervousness by a gentle alternate patting of the front feet on the floor of the cage. Then there appears to be an itching in the nose as the rat frequently goes through vigorous cleaning reactions over that region. Soon the animal begins to sneeze and the nose drips a colorless fluid. This symptom reminds one of a severe case of hay fever. The sneezing continues and finally develops into convulsive reactions. At this time the animal is very sensitive to touch, so that if even the fur is lightly touched the animal jumps and squeals. Salivation begins with the sneezing and continues so that the mouth becomes quite frothy. At about this time the animal will insert its toes within its mouth as though trying to dig out some object in its throat. In many of the cases urination and defecation result. The eyes are dull and glassy. In some animals the nose bleeds. The hind legs become paralyzed. Finally the animal falls on its side, breathes heavily and then gradually succumbs. Death seems to be due to edema of the lung.

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[1] W. J. Baerg, *Natural History*, 42: 1, 42, June, 1938.

[2] Tentatively determined from H. E. Ewing's key in "The Scorpions of the Western Part of the U. S." No. 2730 of the Proceedings of the U. S. National Museum, Vol. 73, Art. 9, pp. 1–24, 1928.

In the children observed the reactions of the victims of *C. sculpturatus* are very similar to those shown by the white rat but extend over a greater period of time. In the case of the eight-year-old child noted above, death occurred within seven hours after the sting. *V. spinigerus* sting causes a local redness and swelling in the region of the sting. Sometimes a small white spot appears around the sting in addition to the above reactions. The writer has not observed any case of *H. hirsutus* sting in man.

Upon request, the Institute of Hygiene of the Department of Public Health, Popotla, D. F., Mexico, graciously sent gratis two ampullae of their anti-scorpion serum prepared for use on victims of *C. suffusus* and *C. noxius*, two deadly Mexican scorpions. This serum was tried on rats stung by *C. sculpturatus* and found effective, even though the animals were in advanced stages of poisoning. Since then the serum has been tried on human victims of *C. sculpturatus*. In all cases it has proved entirely effective, and no deaths have resulted from scorpion sting, even though the serum was used in quite advanced stages of poisoning.

H. L. Stahnke

Iowa State College and
Mesa Union High School,
Mesa, Ariz.

STIMULATION OF KUDZU CUTTINGS

In view of its desirable growth characteristics in soil conservation work, kudzu is an important plant in the South. However, successful propagation of this plant from seeds and cuttings on a large scale has been limited.

In October, 1937, the Horticultural Department of the University of Georgia and the Soil Conservation Service, in Athens, started a cooperative project for the study of kudzu propagation. In the first greenhouse trial, three commercial synthetic hormone products were used at recommended dilutions for recommended durations. The results given in Table I were obtained after fourteen days.

TABLE I

Commercial product	No. set out	No. rooted	No. unrooted	Per cent. of cuttings rooted
'A' Dilute	75	51	22	68
'A' Standard ..	75	64	11	85
'B' Dilute	75	46	24	61
'B' Standard ..	75	47	27	63
'C' Dilute	72	48	23	67
'C" Standard ..	75	39	27	52
Untreated	75	38	33	51

The results from this trial indicated that cuttings treated with hormones produced a higher percentage of strikes than untreated ones. However, the most noticeable effect was the increase in size and number of roots per cutting. This indication was considered sufficient to justify a second trial, using the material that had given the best results. In addition to this superior hormone product, it was decided to include a comparative test using potassium permanganate, one ounce to eight gallons of water for thirty minutes, which had given good results in previous tests with ornamentals. The results obtained after a thirty-day period are given in Table II.

TABLE II

	No. planted	No. rooted	No. unrooted	Per cent. rooted
Check no. treatment	302	128	174	42.4
'A' Standard	300	160	140	53.3
'A' Standard + ...	150	90	60	60
'A' Standard ++ ...	299	127	172	42.5
Potassium Permanganate ..	150	129	21	86

The second trial confirmed the indications of the first in that the treated rooted cuttings showed an increase in the number and size of roots over the untreated ones. The indications are that the potassium permanganate is superior to any hormone product yet tested for kudzu, both as to percentage of strike and size and number of roots developed. The stimulating results obtained through the use of potassium permanganate warrant further studies.

M. C. Myers
Roy A. Bowden

Horticultural Dept.,
University of Georgia

F. E. Hardisty

Soil Conservation Service,
Athens, Georgia

"A CROSS-SECTION OF OUR TIME"

As part of its activity in connection with the New York World's Fair of 1939 the Westinghouse Company is considering the preservation of a "Cross-section of our Time" in a large capsule of copper alloy, to be deposited deep in the earth at the site of the fair, with proper ceremony, some time late in September of this year. The capsule, which has engaged considerable engineering and metallurgical attention, is to be so constructed as to last 5,000 years. The articles in the interior, which are being selected with the advice of archeologists, historians, technical societies and others, are to be preserved in an inner glass crypt, filled with nitrogen or other inert gas.

Though the interest and cooperation of many scientific men has already been obtained through personal interview and by letter, we feel that the project needs and merits the suggestions and advice of as large a cross-section of the scientific community as possible. Many questions present themselves, such as: What method should be used for the preservation of the items in the "Time Capsule"? Should books be reduced to microfilm, and will this last? What books, what small physical objects, what pictures, etc., will best present a picture of ourselves and our times to the people of *circa* 6939? What key to our language may we leave which will enable them to translate and understand what is in the capsule? How best may we leave word of the location of this capsule for the archeologists of such a distant future?

We welcome suggestions on these and other questions. As time is short, we urge scientific men to let us have at once their thoughts on this project.

D. S. YOUNGHOLM,
Vice-president, Westinghouse Electric and Manufacturing Company

SOCIETIES AND MEETINGS

THE KANSAS ACADEMY OF SCIENCE

THE seventieth annual meeting of the Kansas Academy of Science was held at the Kansas State Teachers College, Pittsburg, March 31, April 1 and 2, 1938. Cooperating with the academy and meeting at the same time was held the thirty-fourth annual meeting of the Kansas Association of Teachers of Mathematics under the chairmanship of Miss Anna Marm, of Lindsborg; The Kansas Section of the Mathematical Association of America under the leadership of Vice-president C. B. Tucker, of Emporia; the Kansas and Nebraska chapters of the American Association of University Professors, with Professor D. A. Worcester, Lincoln, Nebraska, regional chairman; and the Kansas Entomological Society, which is affiliated with the academy as the section on entomology under the leadership of Vice-president L. C. Woodruff, Lawrence.

Dr. Leo Christiansen addressed the first meeting on Thursday evening under the joint auspices of the South East Kansas Section of the American Chemical Society and the academy on "The Farm Chemurgic." Academy business sessions of an hour each were held on Friday and Saturday mornings on April 1 and 2. The remainder of the time during the two days was devoted to section meetings. A section on geology and one for science teachers were organized during the year and met as sections for the first time. Table I presents a report of the sessions.

The senior and junior banquets were held on Friday evening at the college cafeteria with an attendance of 180 at the senior banquet and 125 at the junior academy banquet. Dr. W. H. Schoewe, president-elect, served as toastmaster. President W. A. Brandenburg, of the college, responded with an address of welcome to the two groups. Professor George A. Dean gave the president's address on the subject, "The Contributions from Kansas to the Science of Entomology." The group then adjourned to the college auditorium to hear the annual invitation address, given this year by Dr. Lawrence H. Snyder, professor of zoology, Ohio State University, on the subject, "Heredity and Human Affairs," before an audience of approximately five hundred.

TABLE I

Section	Chairman	No. of papers	Total attendance	Chairman for 1938–1939
Botany	Miss Margaret Newcomb	28	40	C. C. McDonald, Wichita
Geology	J. M. Jewett	16	47	D. C. Schaffner, Emporia
Psychology	O. W. Alm	17	75	Joseph W. Nagge, Emporia
Zoology	C. E. Burt	20	75	Earl H. Herrick, Manhattan
Physics	C. V. Kent	11	35	Penrose Albright, Winfield
Chemistry	Lloyd McKinley	10	60	Fayette T. Owen, Emporia
Junior Academy	Oscar Klingman		300	Bill Akey, Pittsburg
Kansas Entomological Society	L. C. Woodruff	16	35	L. C. Woodruff, Lawrence
Science Teachers	W. J. Baumgartner	9	125	Lorene Bailey, Parsons, Biology Lawrence Oncley, Winfield, Phy. Sciences
Mathematical Association of America	Chas. B. Tucker	4	50	Chas. B. Tucker, Emporia
Kansas Association of Teachers of Mathematics	Miss Anna Marm	2	75	Miss Minnie Stewart, Topeka
University Professors	D. A. Worcester	7	50	D. A. Worcester, Lincoln, Nebr.

Trips to the strip coal mines, deep mines and a coal washer near Pittsburg, Kansas, were arranged for members and visitors. Progress in reclaiming former strip coal land was pointed out.

Committee progress was indicated in reports at the business meeting. The committee on natural areas prepared a descriptive illustrated pamphlet on "Rock City," an area of most unusual rock formations near Minneapolis, Kansas, which the committee hopes to preserve for posterity by means of a state or national monument. The pamphlet was widely distributed, and the rock city project has attracted attention in other states. The committee on science teaching in the secondary schools, with Dr. O. W. Alm, Kansas State College, chairman, made a survey of the subject in 235 high schools in cities of first, second and third classes and prepared an extended report of their findings for publication. The membership committee reported 180 new members during the year, with 740 on the membership roll. The committee on research awards, with Dr. L. D. Wooster, chairman, made the following awards for the ensuing year: To Dr. Edwina A. Cowan, director of the Child Research Laboratory, Friends University, Wichita, $40 from the American Association for the Advancement of Science and academy funds, for the purchase of a chronoscope to assist in her studies on constitutional types of children; to Dr. Frank C. Gates, Kansas State College, Manhattan, $42.50 from the academy treasury for assistance in the study of the distribution of flowering plants and ferns of the state; to Dr. John Breukelman, Kansas State Teachers College, Emporia, $32.50, which is award No. 2 of the Albert B. Reagan endowment fund for aid in his studies on the distribution of Kansas fishes; to Professor H. R. Bryson, assistant professor of entomology, Kansas State College, $25 from the A. A. A. S. fund to pay for drawings of Elateridae of Kansas; to Dr. Mary T. Harman, professor of zoology, Kansas State College, $42.50 from the academy fund to aid in her studies of the development of pigment in the hair and skin of guinea pigs; and to Dr. Roger C. Smith, professor of entomology, Kansas State College, $25 from the A. A. A. S. fund to pay for photographs of grasshopper eggs. The $75 from the A. A. A. S. was augmented by $100 from the academy treasury, providing a total of $207.50 for research funds for the coming year.

Dr. H. A. Zinszer, the treasurer, was designated representative to the Academy Conference at the Richmond meeting.

Possibly the outstanding accomplishment of the year was made by the Junior Academy of Science committee, which consisted of Dr. J. Ralph Wells, Kansas State Teachers College, Pittsburg, *chairman*, Miss Edith Beach, Lawrence, and J. A. Brownlee, Wichita. They reported a total of 17 affiliated Junior Academy groups, 11 of which were organized since the last meeting. The junior academy meeting consisted of the induction of the 11 new clubs and a full afternoon of individual and group demonstrations. The Lawrence, Jr. High School group was awarded first place and will be given temporary custody of the loving cup to be bought for this recognition.

The American Association of University Professors held two sessions. Dean C. M. Correll, of Kansas State College, was chairman of the morning session at ten o'clock. Dr. C. M. Street presided at the luncheon meeting at twelve thirty. An important action written by the association was the establishment of a committee to bring about closer cooperation between the local chapters within the State of Kansas. The committee is to consist of one member from each chapter. Robert W. Conover, of Kansas State College, was appointed chairman.

The Kansas Academy inaugurated the plan last year of selecting the president a year in advance, thus giving him a preparatory year to think about his plans, aims and committees. Dr. W. H. Schoewe, professor of geology at the University of Kansas, was made president-elect last year and came to the meetings this year with a well-prepared organization plan and a list of carefully selected committee members. He initiated his term as president for the coming year at the business meeting on Saturday. Dr. H. H. Hall, Kansas State Teachers College, Pittsburg, Kansas, was selected as the president for 1939 with the title of president-elect. Other officers elected were as follows: *Vice-president*, Dean E. O. Deere, Bethany College, Lindsborg; *Secretary*, Roger C. Smith, Manhattan; *Treasurer*, H. A. Zinszer, Hays; *Members of the Executive Council*, Geo. A. Dean, Manhattan, Lawrence Oncley, Winfield, and R. H. Wheeler, Lawrence; *Editor*, Frank C. Gates, Manhattan; *Associate Editors*, R. E. Mohler, McPherson, and Robert Taft, Lawrence.

A total of 236 members registered for the meeting. The next annual meeting will be held in Lawrence at the University of Kansas about April 1, 1939.

ROGER C. SMITH,
Secretary

JOINT MEETING OF COLLEGE PHYSICS TEACHERS AT URBANA, ILLINOIS

THE physics teachers of the area outside of Chicago held an organization meeting at the University of Illinois on November 6, 1937. A general committee on arrangements was appointed at the time, consisting of Professor L. I. Bocksthaler, of Northwestern University; Professor R. Ronald Palmer, of James Millikin University, and Professor R. F. Paton, of the University of Illinois.

In the Chicago area such an organization has been in operation for some time. At the suggestion of the down state committee a joint meeting was arranged. This met in the Laboratory of Physics of the University of Illinois on Saturday, April 23, 1938.

A program of ten papers was presented, dealing with the present-day problems of the physics teacher, by representatives from the University of Chicago; Western State Teachers College, Macomb; Eastern State Teachers College, Charleston; the University of Illinois; Woodrow Wilson Junior College, Chicago; and Bradley Institute.

Active interest was expressed throughout, and discussions followed each paper. Among the important recommendations discussed and passed were: (1) Full cooperation with the state committee in its endeavor to raise the teaching standard of physics in the state. (2) The joint session favors that a minimum of 16 hours of college physics be required of prospective high-school teachers of physics; however, that this recommendation should not be immediately applied to teachers already in service.

The attendance was thirty-two. Twenty-one of the leading educational institutions of the state were represented at the meeting. The down state club continued the general committee--Bocksthaler, Palmer, Paton—with instructions to arrange for the next meeting.

CHAS. T. KNIPP,
Secretary

UNIVERSITY OF ILLINOIS

SPECIAL ARTICLES

SOLUTIONS OF CHLOROPHYLL-PROTEIN COMPOUNDS (PHYLLOCHLORINS) EXTRACTED FROM SPINACH

THE differences in solubility, fluorescence and absorption spectrum between the green pigments in the leaf and the chlorophylls extracted in solvents such as alcohol have been ascribed either to dispersion of the green pigments in the leaf, or to adsorption or combination of the chlorophyll with lipoid or protein.[1] We have prepared aqueous solutions of the green pigments which show characteristic protein properties and which resemble the pigments in the leaf. To distinguish them from the chlorophylls we have adopted the name *phyllochlorin* for these chromoproteins, as suggested by Mestre.

Our extracts have been prepared using dilute aqueous digitalin, a solvent currently used for the photosensitive retinal pigments.[2] Ordinary leaf press juice or distilled water extracts show the green pigments not in true solution,[3] but in a fine suspension whose particles are visible under the microscope and can be retained on a fine filter.

About 100 gm of fresh spinach is thoroughly ground with fine sand, water is added to make 100 ml, and the suspension filtered through a coarse fluted filter. The moist cake is reground and again extracted. To the combined extracts is added 5 gm of Filter-Cel.[4] per 100 cc, and the whole is filtered through a thin layer of Filter-Cel. on a Buchner funnel. The deep yellow-brown filtrate is discarded. The cake is washed in distilled water several times until the filtrate shows no trace of yellow color. It is then extracted with 25 ml of 1 or 2 per cent. aqueous digitalin;[5] the result is a dark green solution which shows no trace of suspended material under an oil immersion lens. Similar preparations can be made with 4 per cent. purified bile salts. More dilute extracts are obtained in concentrated (40–50 per cent.) urea solutions. Digitalin solutions of the phyllochlorin kept for some weeks in the cold room (5° C.) show a little precipitated pigment which does not redissolve.

The absorption bands of the phyllochlorin (Fig. 1), measured with Shlaer's spectrophotometer,[6] are like those of the leaf and are shifted towards the longer

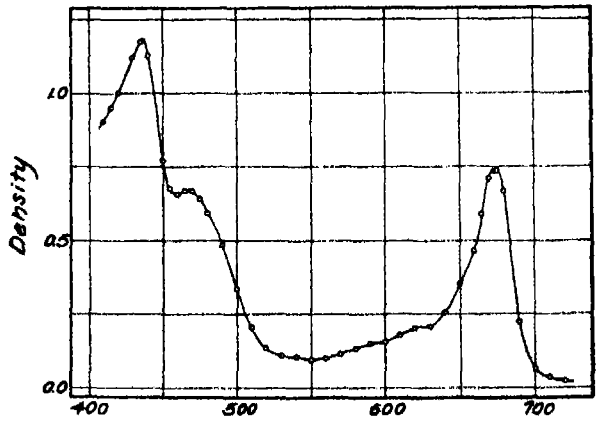

FIG. 1. The absorption spectrum of a phyllochlorin solution prepared with 2 per cent. digitalin and diluted 1 to 10 with distilled water. The density values are for a 5 mm depth of solution.

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[1] Reviewed by H. Mestre in "The Investigation of the Pigments of the Living Photosynthetic Cell," in Contributions to Marine Biology, Stanford University Press, 1930.

[2] *e.g.*, K. Tansley, *Jour. Physiol.*, 71: 442, 1931; A. M. Chase and C. Haig, *Jour. Gen. Physiol.*, 21: 111, 1938; G. Wald, *Nature*, 140: 545, 1937.

[3] T. B. Osborne and A. J. Wakeman, *Jour. Biol. Chem.*, 42: 1, 1920. Such suspensions have also been studied by V. Lubimenko, *Rev. Gen. de Bot.*, 39: 547, 1927; and B. Hubert, *Rec. trav. bot. néerl.*, 32: 324, 1935.

[4] Filter-Cel., Johns-Manville, New York.

[5] Crystalline digitalin, Eimer and Amend, New York.

[6] S. Shlaer, *Jour. Opt. Soc. America*, 28: 18, 1938.

wave-lengths as compared with the natural mixtures of chlorophyll *a* and *b*.[7] The three bands are at 437, 470 and 675 mμ, while those for chlorophyll are at 420, 465 and 660 mμ. The 420 and 660 mμ maxima of chlorophyll have about the same height, while for phyllochlorin solutions the 437mμ maximum is always 60 per cent. higher than the 674 band. This suggests the presence of carotenoids associated with phyllochlorin, such as French[8] found for the chromoprotein solutions from photosynthetic purple bacteria.

Boiling a neutral digitalin extract shifts the red absorption band towards the shorter wave-lengths. When a solution is made strongly acid or weakly acid and boiled, the solutions turn yellow, corresponding to the formation of phaeophytins. A digitalin extract saturated with solid ammonium sulfate precipitates the phyllochlorin only after several days, but when boiled forms a bright green viscous mess. No pigment is lost on prolonged dialysis (about two weeks) of a digitalin extract, and only a part of the pigment precipitates. This precipitate, separated by centrifuging, does not readily redissolve in digitalin solution. The pigment which remains in solution is now readily precipitated with high concentrations of ammonium sulfate. Such precipitates are easily redissolved in digitalin solution but not in water. It is likely that the solvent action of the digitalin and the bile salts is due to the formation of coordination compounds which are not broken up even on prolonged dialysis. Phyllochlorin is precipitated and the chlorophyll extracted by strong alcohol, methyl alcohol or acetone but not by petroleum ether in agreement with the effects of these solvents on the leaf. Phyllochlorin solutions show a positive Biuret reaction.

In agreement with observations of the green leaf, phyllochlorin solutions show little or no red fluorescence when irradiated with blue light (436 mμ). This is in contrast with the strong red fluorescence of alcoholic chlorophyll solutions. Phyllochlorin solutions are quite stable to visible light.

The behavior of phyllochlorin solutions in strong centrifugal fields is being investigated in collaboration with Dr. E. G. Pickels[9] using an air-driven ultracentrifuge.[10] Preliminary studies show that the phyllochlorin when subjected to a force of 160,000 gravity can be sedimented completely through a 10 mm column of the liquid medium within three hours, leaving no color in the supernatant fluid. Our best preparation showed two sedimentation boundaries which correspond to particles of high molecular weight, *i.e.*, above 70,000. The two boundaries retained their identity with respect to their sedimentation rates when studied by the light absorption method in the red and blue regions corresponding to the absorption maxima of phyllochlorin in the visible, and in the ultra-violet region characteristically absorbed by proteins. One boundary sedimented almost twice as fast as the other; these more rapidly moving and presumably heavier particles showed a greater total absorption in each of the two regions of the visible spectrum than did the smaller particles.

It is tempting to assume that these two proteins correspond with phyllochlorins *a* and *b*. The similarity of sedimentation properties throughout the spectrum indicates that the additional blue absorption is characteristic of the phyllochlorins and not of some other component.

It now appears that the classical organic chemical studies of the chlorophylls and carotenoids were concerned with the prosthetic groups of extremely complex specific catalysts, perhaps analogous to the hemoglobins and enzymes such as cytochrome, catalase and the yellow respiratory enzyme. Presumably there are many additional components concerned in photosynthesis, since phyllochlorin does not carry on photosynthesis *in vitro*.

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[7] *c.f.* E. Rabinowitch and J. Weiss, *Proc. Roy. Soc. London*, A, 162: 251, 1937.

[8] C. S. French, Abstract in the Proceedings of the American Society of Biological Chemists, Baltimore meeting, March 30–April 2, 1938.

[9] Of the Laboratories of the International Health Division, The Rockefeller Foundation, New York.

[10] J. H. Bauer and E. G. Pickels, *Jour. Exp. Med.*, 65: 565, 1937.

OVINE AND BOVINE LISTERELLOSIS IN ILLINOIS

The pathogenesis of organisms of the genus Listerella and their possible etiologic significance in rodent septicemia have been reported in England[1] and South Africa,[2] while in New Zealand[3] sheep suffering from an encephalitic syndrome, designated "circling disease," has been associated with or attributed to Listerella infection. In the United States, Listerella has been isolated from cattle,[4] sheep[5] and man,[6,7] displaying symptoms of encephalitis, and from chickens[8] that disclosed lesions of necrotic myocarditis. So far as we are aware, listerellosis in sheep and cattle showing an encephalitic and/or an encephalomyelitic syndrome has not been reported in central United States. However, Doyle[9] described an idiopathic encephalitis of sheep in Indiana accompanied by gross and microscopic changes in the brain analogous to ovine Listerella infection encountered in Illinois during the winter of 1937–38.

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[1] E. G. D. Murray, R. A. Webb and M. B. R. Swann, *Jour. Path. and Bact.*, 29: 407, 1926.

[2] J. H. H. Pirie, *So. African Inst. Med. Res.*, 3: 163, 1927. Cited by Gill.

[3] Dudley A. Gill, *Vet. Jour.*, 87: 60, 1931 and 89: 258, 1933; *Australian Vet. Jour.*, 13: 46, 1937.

[4] F. S. Jones and R. B. Little, *Arch. of Path.*, 18: 580, 1934.

[5] Erwin Jungherr, *Jour. A. V. M. A.*, 91: 73, 1937.

[6] Caspar G. Burn, *Jour. Bact.*, 30: 573, 1935; *Am. Jour. Path.*, 12: 341, 1936.

[7] E. W. Schultz, M. C. Terry, A. T. Brice and L. P. Gebhardt, *Proc. Soc. Exp. Biol. and Med.*, 31: 1021, 1934. Cited by Burn.

[8] C. V. Seastone, *Jour. Exp. Med.*, 62: 203, 1935.

In this paper reference is made to two outbreaks of ovine and one outbreak of bovine encephalitis and/or encephalomyelitis associated with Listerella. The first outbreak coming to the attention of the Illinois Agricultural Experiment Station occurred in a group of 250 feeder lambs that had been purchased at a central market. Lambs of this type for fattening generally originate in western grazing states, but the origin and history of the animals comprising this shipment were not determined. Approximately six weeks following arrival of the lambs on a farm in DeWitt County, Ill., symptoms of illness developed. The symptoms consisted of depression, weakness, incoordination, fever, walking in circles, pushing against objects with the head, anorexia and progressive paralysis, terminating in coma and death. Approximately 30 lambs died or became moribund and were destroyed and a few mildly affected lambs apparently made a complete recovery. An ophthalmia of transitory nature was noted in some of the mildly affected lambs. The same lesion was also observed at autopsy of fatally affected lambs.

Five of the typically affected lambs from this flock came to autopsy. Each yielded Listerella-like organisms from the brain stem on liver agar plates and/or in tubes of meat mash media incubated at 37.5° C. Bacteriologically sterile brain tissue filtrates (Berkefeld N) proved negative to demonstrable virus upon intracerebral inoculation of rabbits, guinea pigs and chickens.

The second outbreak occurred in a flock of 100 breeding ewes in DeWitt County, but so far as determined, had no connection with the first outbreak. A small number of the breeding ewes in this flock displayed symptoms involving the central nervous system with a mortality of six ewes. One of the clinically affected animals was submitted for observation and autopsy. An organism possessing characters of the genus Listerella was iolated from the brain stem.

A third outbreak showing an encephalitic and/or encephalomyelitic syndrome was observed in a group of 60 yearling feeder steers in Piatt County, Ill. The principal symptoms were glassy, dazed expression of eyes, partial paralysis of mandible, elevation of the head and salivation. Affected animals became prostrate and remained comatose for three to four days before death. Listerella-like organisms were isolated from the brain stem of two fatally affected steers.

Postmortem examination of naturally affected lambs and ewes in two outbreaks did not reveal any marked gross pathologic changes in the internal organs. In some of the lambs the cervical and visceral lymph nodes were enlarged and slightly edematous. There was an increased amount of slightly cloudy cerebrospinal fluid with slight congestion of the meninges. In one case gross lesions suggestive of a localized meningitis were noted. The blood picture of five of the natural ovine cases did not show any significant deviation from the normal.

An examination of stained sections from the brain of naturally affected lambs and cattle showed polymorphonuclear and mononuclear foci in the stem and in the white matter of the cerebrum and cerebellum, together with perivascular cuffing with mononuclear cells and a mononuclear meningitis.

The pathogenic properties of Listerella strain isolated from one outbreak in sheep have been established by artificial exposure of healthy lambs, calves, chickens, guinea pigs, rabbits and rats, while cultural and biochemic properties of the strains from the three outbreaks described herein conform to the genus Listerella. It appears that three natural outbreaks (two in sheep and one in cattle) in Illinois, accompanied by symptoms of encephalitis and/or encephalomyelitis, were associated with Listerella infection.[10]

Robert Graham
G. L. Dunlap
C. A. Brandly

THE EFFECT OF NUCLEOPHOSPHATASE ON "NATIVE" AND DEPOLYMERIZED THYMONUCLEIC ACID

It has been definitely established that desoxyribonucleic acids differ in their molecular weight, depending upon their method of preparation. The substance prepared by E. Hammarsten[1] seems to be the unchanged acid as it occurs in the cells of the thymus gland and of fish sperm (in combination with histone in the former and with protamine in the latter); according to investigations with various methods[2] (filtration and ultracentrifugation) its molecular weight is approximately 1,000,000. It may therefore be referred to as the "native" desoxyribonucleic acid.

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[9] L. P. Doyle, *Jour. A. V. M. A.*, 81: 118, 1932.

[10] After dictating the above report on the occurrence of Listerellosis in cattle and sheep in Illinois, attention was called to an article on "Listerella Infection in Fowls in East Anglia" by Dr. J. Stuart Paterson, Institute of Animal Pathology, Cambridge University, published in *Veterinary Record* 49: 49, 1937, with reference to spontaneous Listerella in four separate groups of fowls, as follows:

a. Two adult fowls were involved, and in both cases death occurred suddenly.

b. One hundred and twenty out of 200 Leghorn pullets died during a period of three months. In addition to the presence of organisms of the Listerella group, *B. pullorum* was recovered from some of the pullets and there was also a heavy infestation of tapeworms (*Davainea proglottina*).

c. Four hundred pullets and 24 stock cockerels comprised the affected unit. The losses were 190 pullets and one cockerel. In several of the pullets from which Listerella were recovered, lesions of fowl paralysis (neurolymphomatosis) were also present.

d. Eight out of 24 young poultry died.

[1] E. Hammarsten, *Biochem. Zeits.*, 144: 383, 1924.

Thus far the molecular weight has been determined definitely for the "native" nucleic acid only. Complete *depolymerization of the acid to a single tetra*nucleotide has not yet been accomplished by chemical means.

On the other hand, by a specific enzyme obtained for the pancreas gland, Feulgen[3] succeeded in transforming the "native" nucleic acid to a tetranucleotide which differs from the "native" nucleic acid in certain physical properties and which is referred to in the literature as "b" nucleic acid.

In collaboration with Dr. E. G. Pickels,[4] we compared the behavior of "native" and "b" nucleic acid in the ultracentrifugal field with the result that the "b" form did not sediment at all, whereas the "a" form (prepared according to Neumann) settled down in a cleared boundary indicating particles of molecular weights between 200,000 and 1,000,000. These results represent the exact proof for Feulgen's assumption, that the enzymic transformation from "native" nucleic acid into the "b" form is a depolymerization.

Even though the molecular weight of "b" nucleic acid has not yet been determined, still it is not improbable that it represents a single tetranucleotide, for the reason that its behavior towards nucleophosphatase[5] is entirely different from the nucleic acids of higher molecular weight. We now find that the so-called "b" nucleic acid is the only one entirely dephosphorylated by the phosphatase, whereas the "native" desoxyribonucleic acid is not affected by this nuclease at all. Only when contaminated with the depolymerase does phosphatase affect nucleic acids of the high molecular weight.

This find, then, is of significance not only because it brings out an additional step in the process of biological catabolism of nucleic acids, but also because it furnishes a means of testing the purity of "native" nucleic acid, on one hand, and of testing the purity of a nucleophosphatase by means of the native nucleic acid, on the other.

It will be of significance also in connection with other questions bearing on the structure of nucleoproteins.

The method of preparation of nucleophosphatase free from depolymerase will be given in detail elsewhere.

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SCIENTIFIC APPARATUS AND LABORATORY METHODS

A SIMPLE RECORDER FOR PHYSIOLOGICAL VOLUME CHANGES

As a sensitive recorder of small changes in volume, the bellows recorder devised by Brodie in 1902[1] has no equal. Its usefulness is limited, however, by the fact that it is tedious to build satisfactorily, especially since the membranes used in its construction are perishable and must be replaced frequently.

We have used in this laboratory for the past year a volume recorder which retains the principle of the Brodie apparatus, yet which can be made air-tight without difficulty, and in which the perishable membrane can be replaced in a few moments. The apparatus has found so many uses in both the student and the research laboratories that it seems to merit a brief description.

The construction of the recorder is shown in the accompanying sketch. The membrane *a* is a light, inelastic balloon, made by tying a commercially prepared sheep's cecum to the lead tube *b*. The sheep's cecum is sold as a contraceptive sheath. It is softened by soaking in 50 per cent. glycerol solution for a few minutes before tying. The lead tube passes through the center of a metal base, *c*, made concave to conform to the shape of the balloon. The lead tube is of rubber,

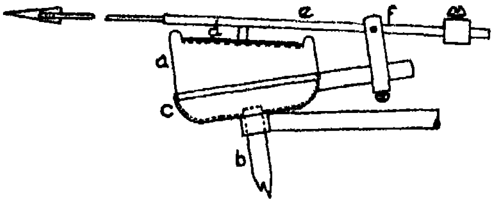

FIG. 1

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[2] R. Signer, T. Caspersson and E. Hammarsten, *Nature*, 146: 122, 1938; W. T. Astbury and F. Bell, *Nature*, 146: 747, 1938.

[3] R. Feulgen, *Zeits. physiol. Chem.*, 237: 261, 1935.

[4] We wish to acknowledge our appreciation to Dr. Pickels for his kind cooperation in this work.

[5] Nucleophosphatase probably consists of two components, one splitting the tetranucleotides into mononucleotides, and one dephosphorylating the latter. In the interest of shortness, we use in this note the term nucleophosphatase for this whole enzyme system.

[1] T. G. Brodie, *Jour. Physiol.*, 27: 473, 1902.

made rigid where it passes through the base by inserting a short segment of glass tubing. It fits the opening in the base snugly, but can easily be drawn up for tying the balloon. The light brass disc, of slightly smaller diameter than the balloon, is firmly attached to the lever *e*, whose fulcrum, at *f*, is adjustable on a rod soldered to the base. The lever is lightly counterpoised beyond the fulcrum. When the balloon has been fitted to its receptacle, it is cemented both to the receptacle and to the brass disc with rubber cement.

In order to smooth out irregularities in the shape of the balloon it has been found desirable to have the lever enough out of balance to raise pressure in the balloon about 5 mm H_2O. If this precaution is taken, there is an almost linear relation between volume change and angular movement of the lever. The range of the recorder is, of course, determined by the volume of the balloon used. Balloons with a volume of about 20 cc have been found satisfactory for most work.

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AN AQUEOUS MEDIUM FOR MOUNTING SMALL OBJECTS[1]

IN the course of investigating a group of small marine copepods the writer has searched for a rapid method of preparing mounts of the parts. Dissecting in glycerin has proved to be very satisfactory, but it was desirable to find a more satisfactory mounting medium than glycerin jelly for the very small parts. Articles recently published in SCIENCE[2, 3] called attention to the possible usefulness of corn syrup (dextrose) and mixtures containing it. In following these suggestions, white Karo syrup alone was tried, but it was found to be very difficult to arrange the parts in position in the syrup, even when a very small drop was used; shifting invariably occurred after the cover-glass was added. With this medium it is also difficult to make the mount thin enough for the use of an oil immersion objective.

Dr. Zirkle's note on mounting media for the Belling acetone-carmine technique suggested a modification which has proved to be very satisfactory. The medium used is essentially Zirkle's mixture without the aceto-carmine:

White Karo syrup	5 cc
Certo (fruit pectin)	5 cc
Water	3 cc

A gram of powdered fruit pectin, dissolved in about 10 cc of water by boiling, may be used instead of Certo. A crystal of thymol is added as a preservative.

In making mounts with this mixture a very small drop is taken up with a fine needle and spread out upon a clean slide. The desired parts are immediately transferred to it and arranged as desired; if the drop is spread out rather thin the smallest parts (*e.g.*, copepod mouth parts) may be quite easily arranged. The mixture begins to "set" in about two minutes, and holds the parts firmly in position. If it should set before all the parts are in position, the excess may be scraped away and a fresh drop added. (The rapidity of setting can be controlled by varying the amount of water used in the mixture). When all parts have been arranged, the mount is dried to hardness over heat. If the cover-glass is put in place with another drop of the mixture a slight shifting of the mounted parts takes place, but this difficulty was overcome by adding the cover-glass with a drop of euparal, which does not dissolve the syrup-pectin mixture. The cover-glass can now be pressed down quite firmly without in the least disturbing the parts. An additional advantage of using euparal is that it can be dissolved off with 95 per cent. alcohol, if necessary, and the cover-glass removed without disturbing the parts. The syrup-pectin mount may then be softened by the addition of a fresh drop of the mixture and the objects rearranged, and the cover-glass added as before. It is not necessary to ring the cover-glass. The refractive properties of the syrup-pectin-euparal combination appear to be satisfactory, although the edges of the drop of syrup-pectin mixture appear as very faint lines.

Various small organisms have been mounted in this medium, both with and without euparal, with results quite as good as for the copepod appendages. If the cover-glass is mounted with the syrup-pectin, sufficient mixture must be used to prevent the formation of air pockets under the cover as the medium dries. Mounts made by the above methods have proved to be very satisfactory for study, and are apparently standing up very well, although none are more than ten months old. The rapidity and effectiveness of the method suggest that it may prove valuable to other workers.

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[1] Contributions from the Scripps Institution of Oceanography, New Series, No. 26.

[2] Ruth Patrick, SCIENCE, 83: 85.

[3] Conway Zirkle, SCIENCE, 85: 528.

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GORTNER, ROSS A. *Outlines of Biochemistry*. Second edition, revised. Pp. xx + 1017. 165 figures. Wiley. $6.00.

READ, WILLIAM T. *Industrial Chemistry*. Second edition. Pp. ix + 605. 115 figures. Wiley. $5.00.

WATERFIELD, R. L. *A Hundred Years of Astronomy*. Pp. 526. Macmillan. $5.75.

WILLIAMS, ROBERT R. and TOM D. SPIES. *Vitamin B₁ and Its Use in Medicine*. Pp. xvi + 411. 19 figures. Macmillan. $5.00.

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VISION IN NATURE AND VISION AIDED BY SCIENCE; SCIENCE AND WARFARE[1]

By The Rt. Hon. LORD RAYLEIGH

PRESIDENT OF THE ASSOCIATION

I. VISION, AND ITS ARTIFICIAL AIDS AND SUBSTITUTES

THE last occasion that the British Association met at Cambridge was in 1904, under the presidency of my revered relative, Lord Balfour, who at the time actually held the position of Prime Minister. That a Prime Minister should find it possible to undertake this additional burden brings home to us how much the pace has quickened in national activities, and I may add, anxieties, between that time and this.

Lord Balfour in his introductory remarks recalled the large share which Cambridge had had in the development of physics from the time of Newton down to that of J. J. Thomson and the scientific school centered in the Cavendish Laboratory, "whose physical speculations," he said, "bid fair to render the closing year of the old century and the opening ones of the new as notable as the greatest which have preceded them." It is a great pleasure to me, as I am sure it is to all of you, that my old master is with us here to-night, as he was on that occasion. I can say in his presence that the lapse of time has not failed to justify Lord Balfour's words. What was then an intelligent anticipation is now a historical fact.

I wish I could proceed on an equally cheerful note. The reputation of the scientific school in the Cavendish Laboratory has been more than sustained in the interval under the leadership of one whose friendly presence we all miss to-night. The death of Ernest Rutherford leaves a blank which we can never hope to see entirely filled in our day. We know that the whole scientific world joins with us in mourning his loss.

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[1] Address of the President of the British Association for the Advancement of Science, Cambridge, August, 1938.

Lord Balfour's address was devoted to topics which had long been of profound interest to him. He was one of the first to compare the world picture drawn by science and the world picture drawn by the crude application of the senses, and he emphasized the contrast between them. A quotation from his address will serve as an appropriate text to introduce the point of view which I wish to develop this evening.

"So far," he said, "as natural science can tell us, every quality or sense or intellect which does not help us to fight, to eat and to bring up our children, is but a by-product of the qualities which do. Our organs of sense perception were not given us for purposes of research . . . either because too direct a vision of physical reality was a hindrance, not a help in the struggle for existence . . . or because with so imperfect a material as living tissue no better result could be attained."

Some of those who learn the results of modern science from a standpoint of general or philosophical interest come away, I believe, with the impression that what the senses tell us about the external world is shown to be altogether misleading. They learn, for example, that the apparent or space-filling quality of the objects called solid or liquid is a delusion and that the volume of space occupied is held to be very small compared with that which remains vacant in between. This is in such violent contrast with what direct observation seems to show that they believe they are asked to give up the general position that what we learn from our senses must be our main guide in studying the nature of things.

Now this is in complete contrast with the standpoint of the experimental philosopher. He knows very well that in his work he does and must trust in the last resort almost entirely to what can be seen and that his knowledge of the external world is based upon it; and I do not think that even the metaphysician claims that we can learn much in any other way. It is true that the conclusions of modern science seem at first sight to be very far removed from what our senses tell us. But on the whole the tendency of progress is to bring the more remote conclusions within the province of direct observation, even when at first sight they appeared to be hopelessly beyond it.

For example, at the time of Lord Balfour's address some who were regarded as leaders of scientific thought still urged that the conception of atoms was not to be taken literally. We now count the atoms by direct methods. We see the electrometer needle give a kick and we say, "There goes an atom." Or we see the path of an individual atom marked out by a cloud track and we see where it was abruptly bent by a violent collision with another atom.

Again, the theory of radioactive decomposition put forward by Rutherford, however cogent it may have seemed and did seem to those who were well acquainted with the evidence, was originally based on indirect inferences about quantities of matter far too small to be weighed on the most delicate balance. Chemists were naturally inclined to feel some reserve; but in due course the theory led to a conclusion which could be tested by methods in which they had confidence—the conclusion, namely, that lead contained in old uranium minerals ought to have a lower atomic weight than ordinary lead and in all probability to be lighter, and on trying this out it proved to be so. More recently we have the discovery of heavy hydrogen with twice the density of ordinary hydrogen and heavy water which is the source of it.

Lastly, the conclusion that ordinary matter is not really space-filling has been illustrated by the discovery that certain stars have a density which is a fabulous multiple of the density of terrestrial matter. Although this is in some sense a deduction as distinguished from an observation, yet the steps required in the deduction are elementary ones entirely within the domain of the older physics.

This and many other points of view have seemed at first sight to contradict the direct indication of our senses. But it was not really so. They were obtained and could only be obtained by sense indications [illegible] interpreted. As in the passage [illegible] already quoted the senses were not [illegible] developed for purposes of research, and we have in large measure to adapt them to that purpose by the use of artificial auxiliaries. The result of [illegible] to reveal a world which to the unaided senses [illegible]ical.

I have chosen for the main subject of [illegible] a survey of some of the ways in which such adaptations have been made. I shall naturally try to interest you by dwelling most on aspects of the subject that have some novelty; but apart from these there is much to be gleaned of historical interest, and when tempted I shall not hesitate to digress a little from methods and say something about results.

I shall begin with a glance at the mechanism of the human eye, so far as it is understood. I shall show how the compromise and balance between different competing considerations which is seen in its design can be artificially modified for special purposes. All engineering designs are a matter of compromise. You can not have everything. The unassisted eye has a field of view extending nearly over a hemisphere. It gives an indication very quickly and allows comparatively rapid changes to be followed. It responds best to the wave-lengths actually most abundant in daylight or moonlight. This combination of qualities is ideal for what we believe to be nature's primary purpose, that is for finding subsistence under primitive conditions and for fighting the battle of life against natural enemies. But by sacrificing some of these qualities, and in particular the large field of view, we can enhance others for purposes of research. We may modify the lens system by artificial additions over a wide range for examining the very distant or the very small. We can supplement and enormously enhance the power of color discrimination which nature has given us. By abandoning the use of the retina and substituting the photographic plate as an artificial retina, we can increase very largely the range of spectrum which can be utilized. This last extension has its special possibilities, particularly in the direction of using waves smaller than ordinary, even down to those which are associated with a moving electron. By using the photoelectric cell as another substitute for the retina with electric wire instead of optic nerve and a recording galvanometer instead of the brain we can make the impressions metrical and can record them on paper. We can count photons and other particulate forms of energy as well. We can explore the structure of atoms, examine the disintegration of radioactive bodies, and trace out the mutual [illegible]on of the elements. Indeed, by elabor[illegible] of thought a little further almost [illegible] of observational science could b[illegible] within the compass of an hour or [illegible] not be too ambitious. It is not my [illegible] very far from what might, [illegible] of language, fall under the heading [illegible] the powers of the eye.

[illegible] people who have a smattering of science now [illegible] the comparison of the eye with the camera obscura, or better, with the modern photographic camera—with its lens, iris, diaphragm, focussing adjustment and ground glass screen, the latter corresponding to the retina. The comparison does not go very far, for it does not enter upon how the message is conveyed to the brain and apprehended by the mind; or even upon the minor mystery of how colors are discriminated. Nevertheless, it would be a great mistake to suppose that the knowledge which is embodied in this comparison was easily arrived at. For example, many acute minds in antiquity thought that light originated in the eye rather than in the object viewed. Euclid in his optics perhaps used this as a mathematical fiction practically equivalent to the modern one of reversing the course of a ray, but other authors appealed to the apparent glow of animal eyes by lamplight, which shows that they took the theory quite literally. The Arabian author Alhazen had more correct ideas and he gave an anatomical description of the eye, but apparently regarded what we call the crystalline lens as the light-sensitive organ. Kepler was the first to take the modern view of the eye.

The detailed structure of the retina, and its connection with the optic nerve, has required the highest skill of histologists in interpreting difficult and uncertain indications. The light-sensitive elements are of two kinds, the rods and cones. The rods seem to be the only ones used in night vision, and do not distinguish colors. The cones are most important in the center of the field of view, where vision is most acute, and it seems to be fairly certain that in the foveal region each cone has its own individual nervous communication with the brain. On the other hand, there is not anything like room in the cross-section of the optic nerve to allow us to assign a different nerve fiber to each of the millions of rods. A single fiber probably has to serve 200 of them.

The nervous impulse is believed to travel in the optic nerve as in any other nerve, but what happens to it when it arrives at the brain is a question for the investigators of a future generation.

The use of lenses is one of the greatest scientific discoveries: we do not know who made it. Indeed, the more closely we inquire into this question the vaguer it becomes. Spectacle lenses as we know them are a medieval invention, dating from about A.D. 1280. Whether they originated from some isolated thinker and experimentalist of the type of Roger Bacon, or whether they were developed by the ingenuity of urban craftsmen, can hardly be considered certain. There are several ways in which the suggestion might have arisen, but a glass bulb filled with water is the most likely. Indeed, considering that such bulbs were undoubtedly used as burning glasses in the ancient world, and that the use of them for reading small and difficult lettering is explicitly mentioned by Seneca, it seems rather strange that the next step was not taken in antiquity. Apparently the explanation is that the magnification was attributed to the nature of the water rather than to its shape. At all events, it may readily be verified that a 4- or 5-inch glass flask full of water, though not very convenient to handle, will give a long-sighted newspaper reader the same help that he could get from a monocle.

The invention of lenses was a necessary preliminary to the invention of the telescope, for, as Huygens remarked, it would require a superhuman genius to make the invention theoretically.

The retina of the eye on which the image is to be received has structure. We may compare the picture on the retina to a design embroidered in woolwork, which also has a structure. Clearly such a design can not embody details which are smaller than the mesh of the canvas which is to carry the colored stitches. The only way to get in more detail is to make the design, or rather such diminished part of it as the canvas can accommodate, on a larger scale. Similarly with the picture on the retina. The individual rods and cones correspond with the individual meshes of the canvas. If we want more detail of an object we must make the picture on the retina larger, with the necessary sacrifice of the field of view. If the object is distant we want for this a lens of longer focus instead of the eye lens. We can not take the eye lens away, but, what amounts to nearly the same thing, we can neutralize it by a concave lens of equal power put right up to it, called the eyepiece. Then we are free to use a long focus lens called the telescopic objective to make a larger picture on the retina. It must of course be put at the proper distance out to make a distinct picture. This is a special case of the Galilean telescope, which lends itself to simple description. It is of no use to make the picture larger if we lose definition in the process. The enlarged image must remain sharp enough to take advantage of the fine structure of the retinal screen that is to receive it. It will not be sharp enough unless we make the lens of greater diameter than the eye. Another reason for using a large lens is to avoid a loss of brightness.

It seems paradoxical that the image of a star should be smaller the larger the telescope. Nevertheless it is a necessary result of the wave character of light. We can not see the true nature of, for example, a double star unless the two images are small enough not to overlap and far enough apart to fall on separated elements of the observer's retina.

When the problem is to examine small objects we look at them as close as we can: here the short-sighted observer has an advantage. By adding a lens in front of the eye lens to increase its power we can produce a kind of artificial short sight and get closer than we could otherwise, so that the picture on the retina is bigger. This is a simple microscope and we can use it to examine the image produced by an objective lens; if this image is larger than the object under examination we call the whole arrangement a compound microscope.

Given perfect construction there is no limit in theory to what a telescope can do in revealing distant worlds. It is only a question of making it large enough. On the other hand, there is a very definite limit to what the microscope used with, say, ordinary daylight can do. It is not that there is any difficulty in making it magnify as much as we like. This can be done, *e.g.*, by making the tube of the microscope longer. The trouble is that beyond a certain point magnification does no good. Many people find this a hard saying, but it must remembered that a large image is not necessarily a good image. We are up against the same difficulty as before. A point on the object is necessarily spread out into a disc in the image, due to the coarseness of structure of light itself as indicated by its wave-length. I can not go into the details, but many of you will know that points on the object which are something less than half a wave-length, or say a one-hundred-thousandth of an inch apart, can not be distinctly separated. This is the theoretical limit for a microscope using ordinary light, and it has been practically reached. The early microscopists would have thought this more than satisfactory; but the limit puts a serious obstacle in the way of biological and medical progress to-day. For example, the pathogenic bacteria in many cases are about this size or less; and there is special interest in considering in what directions we may hope to go further.

Since microscopic resolution depends on having a fine structure in the light itself, something, though not perhaps very much, may be gained by the use of ultra-violet light instead of visible light. It then becomes necessary to work by photography. We are nearing the region of the spectrum where almost everything is opaque. In the visual region nearly every organic structure is transparent and to get contrast stains have to be used which color one part more deeply than the other. In the ultra-violet, on the other hand, we get contrast without staining and, as Mr. J. W. Barnard has shown, the advantage lies as much in this as in the increased resolving power. For example, using the strong ultra-violet line of the mercury vapor lamp, which has about half the wave-length of green light, he finds that a virus contained within a cell shows up as a highly absorptive body in contrast with the less absorptive elements of the cell. So that ultra-violet microscopy offers some hope of progress in connection with this fundamental problem of the nature of viruses.

With ultra-violet microscopy we have gone as far as we can in using short waves with ordinary lenses made of matter, for the available kinds of matter are useless for shorter waves than these, and it might well seem that we have here come to a definite and final end. Yet it is not so. There are two alternatives, which we must consider separately. Paradoxical as it may seem, for certain radiations we can make converging lenses out of empty space; or alternatively we can make optical observations without any lenses at all.

The long-standing controversy which raged in the nineties of the last century as to whether cathode rays consisted of waves or of electrified particles was thought to have been settled in favor of the latter alternative. But scientific controversies, however acutely they may rage for a time, are apt, like industrial disputes, to end in compromise; and it has been so in this instance. According to our present views the cathode rays in one aspect consist of a stream of electrified particles; in another, they consist of wave trains, the length being variable in inverse relation to the momentum of the particles.

Now cathode rays have the property of being bent by electric or magnetic forces, and far-reaching analogies have been traced between this bending and the refraction of light by solids; indeed, a system of "electron optics" has been elaborated which shows how a beam of cathode rays issuing from a point can be reassembled into an image by passing through a localized electrostatic or magnetic field having axial symmetry. This constitutes what has been called an electrostatic or magnetic lens. It is then possible to form a magnified image of the source of electrons on a fluorescent screen, and that is the simplest application. But we can go further and form an image of an obstructing object such as a fine wire by means of one magnetic lens, acting as objective, and amplify it by means of a second magnetic lens, which is spoken of as the eyepiece, though of course it is only such by analogy, for the eye can not deal directly with cathode rays. The eyepiece projects the image on to a fluorescent screen or photographic plate. So far we have been thinking of the electron stream in its corpuscular aspect. But we must turn to the wave aspect when it comes to consideration of theoretical resolving power. The wave-length associated with an electron stream of moderate velocity is so small that if the electron microscope could be brought to the perfection of the optical microscope, it should be able to resolve the actual atomic structure of crystals. This is very far indeed from being attained, the present electron microscope being much further from its own ideal than were the earliest optical microscopes. Nevertheless, experimental instruments have been constructed which have a resolving power several times better than the modern optical microscope. The difficulty is to apply them to practical biological problems.

It is not to be supposed that the histological technique so skilfully elaborated for ordinary microscopy can at once be transferred to the electron microscope. For example, the relatively thick glass supports and covers ordinarily used are out of the question. Staining with aniline dyes is probably of little use, and the fierce bombardment to which the delicate specimen is necessarily exposed will be no small obstacle. Certain standard methods, however, such as impregnation with osmium, seem to be applicable: and there is some possibility that eventually the obscure region between the smallest organisms and the largest crystalline structure may be explored by electron microscopy.

In referring to the limitations on the use of lenses I mentioned the other alternative that we might, in order to work with the shortest waves, dispense with lenses altogether: and in fact in using x-rays this is done. We are then limited to controlling the course of the rays by means of tubes or pinholes. This restriction is so serious that it altogether defeats the possibility of constructing a useful x-ray microscope analogous to the optical or the electron microscope. In spite of this the use of x-rays is of fundamental value for dealing with a particular class of objects, namely, crystals, which themselves have a regular spacing, comparable in size with the length of the waves. Just as the spacing of a ruled grating (say one 1/20,000th of an inch) can be compared with the wave-length of light by measuring the angle of diffraction, so the spacing of atoms in a crystal can be compared with the wave-length of x-rays. But here the indications are less direct than with the microscope, and depend on the object having a periodic structure. So that the method hardly falls within the scope of this address. How essential the difference is will appear if we consider that the angle to be observed becomes greater and not less the closer the spacing of the object under test.

Color vision is one of nature's most wonderful achievements, though custom often prevents our perceiving the wonder of it. We take it for granted that any one should readily distinguish the berries on a holly bush, and we are inclined to be derisive of a color-blind person who can not do so. But so far anatomy has told us little or nothing of how the marvel is achieved. Experiments on color vision show that three separate and fundamental color sensations exist. It is probable that the cones of the retina are responsible for color vision and the rods for dark adapted vision which does not discriminate color. But no division of the cones into three separate kinds corresponding to the three color sensations has ever been observed. Nor is any anatomical peculiarity known which allows a color-blind eyes to be distinguished from a normal one.

Can artificial resources help to improve color discrimination? In some interesting cases they can. Indeed, the whole subject of spectroscopy may be thought of as coming under this head. We can recognize the color imparted by sodium to a flame without artificial help. When potassium is present as well, the red color due to it can only be seen when we use a prism to separate the red image of the flame from the yellow one. Such a method has its limitations, because if the colored images are more numerous they overlap, and the desired separation is lost. To avoid this it is necessary to make a sacrifice, and to limit the effective breadth of the flame by a more or less narrow slit. And if the images are very numerous the slit has to be so narrow that all indication of the breadth of the source is lost. This, of course, is substantially the method of spectroscopy, into which I do not enter further. But there is an interesting class of cases where we can not afford to sacrifice the form of the *object entirely to color discrimination.* Consider, for example, the prominences of the sun's limb, which are so well seen against the darkened sky of an eclipse, but are altogether lost in the glare of the sky at other times. In order to see them prismatic dispersion is made use of, and separates the monochromatic red light of hydrogen from the sky background. A slit must be used to cut off the latter: but if it is too narrow the outlines of the prominence can not be seen. By using a compromise width it is possible to reconcile the competing requirements in this comparatively easy case. Indeed, M. B. Lyot, working in the clear air of the observatory of the Pic du Midi, where there is less false light to deal with, has even been able to observe the prominences through a suitable red filter, which enables the whole circumference of the sun to be examined at once, without the limitations introduced by a slit. A much more difficult problem is to look for bright hydrogen eruptions projected on the sun's disc, and at first sight this might well seem hopeless. A complete view of them was first obtained by photography, but I shall limit myself to some notice of the visual instrument perfected by Hale and called by him the spectrohelioscope. A very narrow slit has to be used, and hence only a very small breadth of the sun's surface can be seen at any one instant. But the difficulty is turned by very rapidly exposing to view successive strips of the sun's surface side by side. The images then blend, owing to persistence of vision, and a reasonably broad region is included in what is practically a single view. I must pass over the details of mechanism by which this is carried out.

There are now a number of spectrohelioscopes over different parts of the world, and a continuous watch is kept for bright eruptions of the red hydrogen lines. Already these are found to be simultaneous with the "fading" of short radio waves over the illuminated hemisphere of the earth, and the brightest eruptions are simultaneous with disturbances of terrestrial magnetism. At the Mount Wilson Observatory such eruptions have been seen at the same time at widely separated points on the sun, indicating a deep-seated cause. There are therefore very interesting and fundamental questions within the realm of this method of investigation.

We have so far been mainly considering how we may adapt our vision for objects too small or too far off for unassisted sight, and for color differences not ordinarily perceptible. This is chiefly done by supplementing the lens system of the eye by additional lenses or by prisms. We can not supplement the retina, but in certain cases we can do better. We can substitute an artificial sensitive surface which may be either photographic or photoelectric.

That certain pigments are bleached by light is an observation that must have obtruded itself from very early time—*indeed, it is one of the chief practical* problems of dyeing to select pigments which do not fade rapidly. If a part of the colored surface is protected by an opaque object—say a picture or a mirror hanging over a colored wallpaper—we get a silhouette of the protecting object, which is in essence a photograph.

Again, it is a matter of common observation that the human skin is darkened by the prolonged action of the sun's light, and here similarly we may get what is really a silhouette photograph of a locket, or the like, which protects the skin locally. In this case we are perhaps retracing the paths which nature herself has taken: for the evolution of the eye is regarded as having begun with the general sensitiveness to light of the whole surface of the organism.

The sensitivity of at all events the dark adapted eye depends on the accumulation on the retinal rods of the pigment called the visual purple, of which the most striking characteristic is its ready bleaching by light. We can even partially "fix" the picture produced in this way on the retina of, for example, a frog by means of alum solution. This brings home to us how clearly akin are the processes in the retina to those in the photographic plate, even though the complexity of the former has hitherto largely baffled investigation.

There are then many indications in nature of substances sensitive to light, and quite a considerable variety of them have from time to time been used in practical photographic processes. But compounds of silver, which formed the basis of the earliest processes, have maintained the lead over all others. The history of photography by means of silver salts can not be considered a good example of the triumph of the rational over the empirical. For instance, the discovery of developers came about thus. The first workers, Wedgewood and Davy (1802), had found that they got greater sensitivity by spreading the silver salt on white leather instead of paper. An early experimenter, the Reverend J. B. Reade (1837), was anxious to repeat this experiment, and sacrificed a pair of white kid gloves belonging to his wife for the purpose. When he wished to sacrifice a second pair, the lady raised a not unnatural objection, and he said, 'Then I will tan paper.' He treated paper with an infusion of oak galls and found that this increased the sensitivity greatly. It amounted to what we should call exposing and developing simultaneously. But, in using the method, it is easily observed that darkening continues after exposure is over, and this leads to beginning development after the exposure. This step was taken by Fox Talbot a year or two afterwards. Instead of crude infusion of galls he used gallic acid. Later pyrogallic acid was used instead of gallic acid, and still survives.

The use of gelatine as a medium to contain the silver halide was a more obvious idea. But it was not so easy to foresee that the sensitivity of silver salts would be much further increased when they were held in this medium. For long this remained unexplained, until it was noticed that some specimens of gelatine were much more active than others. This was ultimately traced by S. E. Sheppard to the presence of traces of mustard oil, a sulfur compound, in the more active specimens. This, in turn, depends in all probability on the pasturage on which the animals that afford the gelatine have been fed. The quantity present is incredibly small, comparable in quantity with the radium in pitchblende.

(To be concluded)

SCIENTIFIC EVENTS

AGRICULTURAL RESEARCH AT ROTHAMSTED

Lord Feversham, parliamentary secretary to the British Minister of Agriculture, announced recently that the Rothamsted Experimental Station at Harpenden, the oldest agricultural research institution in the world, had been granted £14,500 by the British government to meet half the cost of building extensions. The station hopes to celebrate its centenary in 1943 with a comprehensive building scheme.

According to the London *Times,* the investigations in progress at the experimental field plots and laboratories include research into the "take-all" infective disease, found in all places where there is an alkali light soil, which attacks wheat. In other parts of the world it is a serious disease, and Australia can lose 80 to 90 per cent. of a crop. With the development of mechanized farming the disease has appeared in Great Britain. The fungus persists in the soil, but it has been found that ground rye meal will halve its persistence.

The Department of Entomology is studying the migration of insects and their relation to climatic conditions. Ingenious traps have been arranged, some like glass lobster pots, which have been out in the fields for four years. The catch one night was 70,000 insects. With the data collected the station can get a measure of the total abundance of insects and so issue forecasts. Some of the experimental field plots have been under surveillance for 100 years.

At a luncheon given by the Lawes Agricultural Trust Committee, Lord Radnor, who presided, referred to the importance of Rothamsted. Since 1919 the loss of agricultural land was very nearly 20,000,000 acres, and while only 20 per cent. of this was due to town expansion, there was a considerable area of rough grazing and unproductive land. Many countries, on which Great Britain relied, were finding that the stored fertility of the land was coming to an end and that they would have to find other methods of agricultural production to maintain fertility.

RESEARCH LABORATORIES AUTHORIZED BY THE AGRICULTURAL ADJUSTMENT ACT

Secretary Wallace has announced that research laboratories authorized by the Agricultural Adjustment Act of 1938 will be established in four major farm-producing areas. He also named the surplus farm commodities on which the work will be done during the initial program. Section 202 of the Agricultural Adjustment Act of 1938 instructs the Secretary of Agriculture to establish four regional research laboratories for research on new uses and market outlets for agricultural products. According to the law, funds available for the laboratories and their work must be divided equally among the four.

The areas are to be known as the Southern, Eastern, Northern and Western major farm producing areas. The states included in these areas are:

Southern Area: Alabama, Arkansas, Florida, Georgia, Louisiana, Mississippi, Oklahoma, South Carolina and Texas.

Eastern Area: Connecticut, Delaware, Kentucky, Maine, Maryland, Massachusetts, New Hampshire, New Jersey, New York, North Carolina, Pennsylvania, Rhode Island, Tennessee, Vermont, Virginia and West Virginia.

Northern Area: Illinois, Indiana, Iowa, Kansas, Minnesota, Missouri, Nebraska, North Dakota, Ohio, South Dakota, Wisconsin and Michigan.

Western Area: Arizona, California, Colorado, Idaho, Montana, Nevada, New Mexico, Oregon, Utah, Washington and Wyoming.

In deciding on this grouping of states the distribution and type of agriculture production, farm population, farm income, value of farm property, total population and other facts were taken into account. Secretary Wallace pointed out that it is of first importance that the research load among the four laboratories should be equalized and coordinated for the efficient performance of the task specified by the Congress. This is especially necessary because the total funds available for these laboratories, $4,000,000, must be equally divided among them. He stated that the department had given full consideration to questions bearing on regional interest and unity in each area. They had realized from the beginning that the four major farm producing areas must be so defined and the work so organized that it would be possible ultimately to include in the program, so far as resources permitted, the major surplus commodities of interest to any area. The central idea throughout had been to secure results efficiently. These results would know no boundaries of state or area, but would benefit agriculture throughout the country."

Work in the initial stages of the program will be concentrated on the following farm commodities and their by-products: In the southern laboratory, cotton, sweet potatoes and peanuts; in the eastern laboratory, tobacco, apples, Irish potatoes, milk products and vegetables; in the northern laboratory, corn, wheat and agricultural waste products; in the western laboratory, fruits (other than apples) and vegetables, Irish potatoes, wheat and alfalfa.

Secretary Wallace is planning for a conference within the next two months in each of the areas to consult with research institutions and representatives of producers and of industries.

SYLVATIC PLAGUE LABORATORY OF THE UNIVERSITY OF CALIFORNIA

THE University of California proposes to establish in connection with the Medical School in San Francisco a sylvatic plague laboratory to control sylvatic plague, which is now wide-spread in the rodent population of the western states. The plague, according to observations and studies thus far made, appears, however, to lack the virulence of other contagions, such as bubonic plague, that have appeared in the West in the past.

The establishment of the laboratory has been made possible by a gift of $24,000 from the Rosenberg Foundation of San Francisco. Of this amount $14,000 is to be used for the construction of a building and the balance for research and personnel. It is expected that the building will be ready by October 1. It will include a two-story section 12 feet wide by 36 feet long, and a one-story section 10 feet wide by 18½ feet long. The laboratory will be staffed and administered by the Hooper Foundation. The work of the laboratory will be concentrated on the rodent fleas, the principal carriers. Both the state and the university have been active in the campaign against sylvatic plague for some years past. All interested agencies have formed a Sylvatic Plague Committee, which has devoted itself to the collection of evidence of this plague everywhere on the American Continent and is taking measures to combat it. Anti-plague serum is being kept constantly on hand at the Hooper Foundation.

Four non-fatal human cases of the plague have been bacteriologically proved thus far, and there is said to be strong evidence that a fifth case was infected with the plague bacillus. The plague has taken a considerable toll among the rodent populations of the state, the infected fleas being found on squirrels, chipmunks, chickarees and other forms. The Hooper Foundation has counted thirteen rodents and rodent varieties that suffer from spontaneous plague, the list including squirrels, marmots, chipmunks, prairie dogs, mice and rats.

It is generally believed that the West Coast became infected in the course of the pandemic of 1894, which originated in Hongkong. It is assumed that rats conveyed the seed to the shores of California and spread it to the squirrels. It has now reached Montana and appears to be working eastward.

THE SQUIBB INSTITUTION FOR MEDICAL RESEARCH

E. R. SQUIBB AND SONS have announced the establishment of the Squibb Institution for Medical Research, for which a laboratory building in New Brunswick, N. J., has been erected at a cost of $750,000. It is planned to dedicate the laboratory in October. It is stated in the official announcement that research activity, already underway, has been organized in four main divisions—experimental medicine, pharmacology, bacteriology and virus diseases, and organic chemistry. In addition, the institute will conduct a biochemical laboratory and a medicinal chemistry laboratory.

To provide clinical facilities for the research staff, a plan of hospital affiliation is being worked out by the Division of Experimental Medicine. A free ward of fifteen or twenty beds will be maintained for the observation of patients in connection with various problems being studied at the institute.

Dr. Geo. A. Harrop, since last year director of research at New Brunswick, who was previously associate professor of medicine at the Johns Hopkins University and associate physician of the Johns Hopkins Hospital, has been appointed director of research in charge of the institute. Dr. Harrop will also be at the head of the Division of Experimental Medicine.

Other appointments are:

> Dr. Harry B. van Dyke, professor and head of the department of pharmacology of the Peiping Union Medical College in China, has been made head of the Division of Pharmacology. He was formerly associate professor of pharmacology at the University of Chicago.
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> Dr. Geoffrey W. Rake, chief of the Division of Bacteriology, formerly research associate in the Connaught Laboratories of the University of Toronto, has been placed at the head of the Division of Bacteriology and Virus Diseases. Dr. Rake was previously an associate in the Rockefeller Institute for Medical Research.
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> The head of the Division of Organic Chemistry will be Dr. Erhard Fernholz, formerly of the University of Göttingen and Princeton University, and more recently with the research laboratory of Merck and Company.
>
> Dr. Hans Jensen will be associate in charge of the biochemical laboratory. He was formerly associate in pharmacology at the Johns Hopkins University, where he cooperated with the late Professor John Jacob Abel, since 1932 in the laboratory for endocrine research.
>
> William A. Lott, now of the research laboratory of E.

R. Squibb and Sons, formerly instructor in chemistry at Rutgers University, will be associate in charge of the Medicinal Chemistry Laboratory.

THE SEMI-CENTENNIAL MEETING OF THE GEOLOGICAL SOCIETY OF AMERICA

The semi-centennial meeting of the Geological Society of America will be held at the Waldorf Astoria Hotel, New York City, on December 28, 29 and 30.

According to the preliminary program, Dr. Arthur L. Day, the retiring president, will deliver his address on Thursday evening. This will be followed by a complimentary smoker. On Friday there will be given a special anniversary day program by leading representatives in several major fields of geology.

With this year, the Geological Society of America will complete a fifty-year period of service in geologic science. It was formally organized at Ithaca, New York, in December, 1888, on call of a Special Committee on Organization, composed of Alexander Winchell (chairman), John J. Stevenson (secretary), Charles H. Hitchcock, John R. Procter and Edward Orton. The first meeting, held in conjunction with the American Association for the Advancement of Science, Section E, was attended by thirteen men, only one of whom, Professor Herman LeRoy Fairchild, of Rochester, is still living. This first meeting was called with a pledged membership of 112 men, who became known thereafter as original fellows. The first election resulted in the addition of 14 fellows. Out of this total number, 6 original fellows and 1 elected fellow are still living.

Now, after fifty years, the society has a membership of 700, all but a handful of whom have come into the organization since those early days; and it has seemed appropriate, therefore, to pause at the end of a period which has seen remarkable development in many ways and take stock of accomplishment and responsibilities. To this end, special observance is planned at the annual meeting of 1938.

The quarter-centennial of the society was observed in Princeton in December, 1913. A part of the opening session of the annual meeting of that year was devoted to a symposium on the work of the society, and opportunity was made at the annual dinner for the story of the initiation of the society. The membership at that time was 380. One hundred and thirty fellows attended the quarter-centennial meeting, the total registration being 265.

The Geological Society, as has long been the custom, invites the Paleontological Society and the Mineralogical Society of America to hold annual meetings also at this time and take part in other activities. The Society of Economic Geologists will be represented and will hold a luncheon. The Seismological Society of America also has been invited to hold scientific sessions at this time. Special meetings are also being arranged for the Section of Vertebrate Paleontologists.

In connection with the meeting the following excursions are planned:

Excursion 1. Glacial and Tertiary Geology, Staten Island and New Jersey. Leader, Dr. Meredith Johnson.

Excursion 2. Engineering Geology in the Vicinity of New York. Leaders, Dr. Charles P. Berkey, James F. Sanborn and Thomas Fluhr.

Excursion 3. Geology of the Palisades. Leader, Dr. S. James Shand.

Excursion 4. Airplane Trip over Manhattan Island and Vicinity. Leader, Dr. Girard Wheeler.

RECENT DEATHS

Guy N. Collins, principal botanist in charge of the Division of Genetics and Biophysics of the Bureau of Plant Industry of the U. S. Department of Agriculture, died on August 14 at the age of sixty-six years.

Dr. Abram T. Kerr, professor of anatomy at Cornell University, died on August 15 at the age of sixty-five years. He had been connected with the university since 1900.

Dr. Edwin Beer, who retired last March as chief of the urological service at Mt. Sinai Hospital, New York City, died on August 13 at the age of sixty-two years.

Dr. G. M. Johnstone MacKay, director of research at the Stamford, Conn., laboratories of the American Cyanamid Company, died on July 29 at the age of fifty-five years.

Dr. Jan Constantijn Costerus, formerly director of the Technical School at Amsterdam, died on July 31 at the age of eighty-nine years. Dr. Costerus is known for the long series of articles he published on plant-teratology, in part with Dr. J. J. Smith.

The death at the age of sixty-five years is announced of Dr. Leo Frobenius, director of the Institute for the Study of Morphology of Civilization in Frankfort-on-Main. Dr. Frobenius led twelve expeditions to Africa. The Frobenius collection at the institute comprises more than 3,500 facsimiles of prehistoric rock paintings and engravings. Dr. Frobenius visited New York last year to attend the opening of an exhibition at the Museum of Modern Art of 200 prehistoric cave drawings from his collection.

Nature records the death on June 19 of the Rev. Dr. W. C. Willoughby, of Birmingham, an authority on the Bantu of South Africa, at the age of eighty-one years, and of Captain F. S. Barnwell, chief designer of the Bristol Aeroplane Company, a pioneer in British aviation, on August 2, aged fifty-eight years.

SCIENTIFIC NOTES AND NEWS

IT is noted in *Nature* that honorary foreign members of the Royal Society of Edinburgh have been elected as follows: Dr. Henry Norris Russell, chairman of the department of astronomy and director of the Observatory, Princeton University; Dr. F. Enriques, professor of mathematics, Royal University, Rome; and Dr. Karl Freiherr von Tubeuf, professor of botany, University of Munich.

A PORTRAIT of Sir D'Arcy Thompson, of St. Andrews University, president of the Royal Society of Edinburgh, was presented to the society at a recent meeting. The portrait was painted by David S. Ewart and the presentation was made by Professor F. A. E. Crew, director of the Institute of Animal Genetics at the University of Edinburgh.

THE Jenner Medal of the Royal Society of Medicine, London, was presented to Sir Arthur Newsholme, late principal medical officer of the London Local Government Board, at a general meeting of the fellows of the society on July 19. The medal is awarded "for distinguished work in epidemiological research or for pre-eminence in the prevention and control of epidemic disease."

DR. ALEXANDER KÖNIG, professor of ornithology at Bonn, has been awarded the shield of nobility of the German Reich, and Dr. Gottlob Linck, professor of mineralogy and geology at Jena, has received the Goethe Medal for art and science.

M. L'ABBÉ HENRI BREUIL, professor of prehistoric ethnography at the Institute of Human Paleontology, Paris, and of prehistory at the Collège de France, has been elected a member of the Académie des Inscriptions et Belles Lettres, in recognition of his work in prehistory and more especially of his studies of the art of the paleolithic age.

DR. PAUL R. BURKHOLDER, associate professor of botany at Connecticut College, has been appointed associate professor at the University of Missouri.

CASPAR G. BURN, assistant professor in pathology at the Yale Medical School, has been appointed associate professor of pathology at the Long Island College of Medicine. He will be in charge of the pathological service recently established at the Kings County Hospital. John Musser Pearce, formerly of the Rockefeller Institute for Medical Research at Princeton, N. J., has been appointed instructor in pathology.

THE following changes have been made in the faculty of chemistry of the Ohio State University: Associate Professors H. L. Johnston and H. V. Moyer have been promoted to professorships; Assistant Professor L. L. Quill to an associate professorship, and P. M. Harris, instructor, to an assistant professorship. Dr. George Eugene MacWood, National Research Council fellow, 1937–1938, has become an instructor. He takes the place of Dr. John Howe, who has resigned.

RECENT promotions at the Michigan College of Mining and Technology include: From associate professor to professor, Dr. R. M. Dickey, head of the department of geology; from assistant professor to associate professor, in forestry, U. J. Noblet; in mathematics, C. G. Stipe and Dr. J. H. Service; from instructor to assistant professor, in mechanical engineering, H. W. Hawn; in chemistry, Dr. R. F. Makens; in electrical engineering, W. O. Ray; in mathematics and physics, T. C. Sermon.

DR. M. F. ASHLEY-MONTAGU, assistant professor of anatomy at New York University, has been appointed associate professor of anatomy in the Hahnemann Medical College, Philadelphia.

DR. ROBERT DOUGLAS LOCKHART, professor of anatomy in the University of Birmingham, has been appointed Regius professor of anatomy in the University of Aberdeen, in the place of Professor A. Low, who recently retired.

DR. F. A. PANETH has been appointed to the university readership in atomic chemistry tenable at the Imperial College—Royal College of Science, University of London. Since 1933 he has been a consultant of Imperial Chemical Industries and has been engaged in research work with postgraduate students at the Imperial College.

DR. A. A. DUNLAP, assistant mycologist and plant physiologist at the Connecticut Agricultural Experiment Station, has taken up his work as chief of the division of plant pathology and physiology at the Texas Agricultural Experiment Station, College Station. He succeeds the late Dr. J. J. Taubenhaus.

DR. RICHARD S. SHUTT, of the American Cyanamid and Chemical Company, has become supervisor of chemical research at the Battelle Memorial Institute, Columbus, Ohio.

CIVIL members of the National Advisory Committee on Aeronautics appointed by President Roosevelt include Clinton M. Hester, administrator of the newly established Civil Aeronautics Authority, and Dr. Vannevar Bush, president-elect of the Carnegie Institution of Washington. Reappointments include: Dr. Joseph Sweetman Ames, formerly president of the Johns Hopkins University; Edward P. Warner, consulting engineer, formerly professor of aeronautic engineering at the Massachusetts Institute of Technology; Professor Jerome C. Hunsaker, head of the department of mechanical engineering at the Massachusetts Institute; Orville Wright and Charles A. Lindbergh.

DR. CHARLES WEISS, director of the Research Laboratories of the Mount Zion Hospital, San Francisco, has received a grant from the Committee on Medical Research of the National Tuberculosis Association to be used for a study of the nature of the lysis of tubercle bacilli in cellular exudates. Dr. Weiss will be assisted by Dr. A. Kaplan, formerly of the department of physiology of the University of California.

DR. CARL L. A. SCHMIDT, dean of the College of Pharmacy and acting dean of the University of California Medical School, has been named a member of the Committee on the Chemistry of Proteins of the National Research Council.

THOMAS J. DUFFIELD, registrar of records and director of the Bureau of Vital Statistics of the Department of Health of New York City, has been appointed an additional American delegate to the forthcoming meeting of the International Commission for the Decennial Revision of the International Nomenclature of Diseases. The meeting opens at Paris on October 3.

DR. D. H. LEHMER, assistant professor of mathematics at Lehigh University, who was recently awarded a Guggenheim fellowship, will work at various English universities on the analytic theory of numbers.

DR. C. E. FORD, demonstrator in botany, King's College, University of London, has been appointed geneticist to the Government Rubber Research Scheme, Ceylon.

AN investigation of the botanical features of the Chihuahuan Desert is being inaugurated through cooperation of the Desert Laboratory of the Carnegie Institution of Washington and the Arnold Arboretum of Harvard University. The area to be covered includes parts of Texas, New Mexico, Chihuahua, Coahuila, Durango, Zacatecas and San Luis Potosi. Work on the vegetation will be conducted by Dr. Forrest Shreve and Dr. T. D. Mallery, of the Desert Laboratory, and the flora will be investigated by Dr. I. M. Johnston, of Arnold Arboretum. Field work is being conducted during August and September in Coahuila and San Luis Potosi.

DR. GÖTE TURESSON, director of the Institute of Plant Systematics and Genetics at the Agricultural College of Sweden, at Uppsala, is making an extended journey in North America this summer. His objective is to collect suitable ecotypes of forest trees for the Swedish Forest Tree Breeding Institution, which has been started at Svalöv, South Sweden. He is assisted by C. G. Alm, curator of the old Linnean Botanical Garden and assistant curator of the Uppsala Botanical Museum. The party is doing field work from the Atlantic to the Pacific both in the United States and in Canada, giving special attention to the forests of British Columbia. Dr. Turesson arrived in May and expects to stay until the latter part of October. His address is Harvard Forest, Petersham, Mass.

DR. DONNEL F. HEWITT, principal geologist in charge of the section of metalliferous deposits of the U. S. Geological Survey, left Washington on August 7 to visit geologic field parties in several western states. He planned also to confer with state and survey officials in regard to projects recently set up under the allotment of funds to the survey by the Public Works Administration. Carl G. Paulsen, chief of the Surface Water Division, returned to Washington on August 8, after visiting several district offices in the West. In California plans were made which will tend to expedite the work related to the investigations and the report on the floods being made by the district office of the survey in California.

THE London *Times* states that J. Hanbury-Tracy has left on a two-year expedition to the Andes of Venezuela. He and Mrs. Tracy will make a collection of plants for the Royal Botanic Gardens, Kew, and a collection of insects for the British Museum of Natural History. Seeds will also be collected for private collectors, and a series of observations will be taken on behalf of the Royal Meteorological Society. The highest point in the Venezuelan Andes rises to over 16,000 feet and the expedition will conduct operations from camps at between 10,000 and 12,000 feet.

DR. JUAN NEGRIN, premier of Spain, professor of human physiology at the University of Madrid and director of the physiological laboratory of the Ramon y Cajal Institute, was at Zurich as a Spanish delegate to the International Physiological Congress. Dr. Negrin is reported, in an Associated Press dispatch, to have said: "I was particularly anxious not to miss this congress. I wanted to show that outside of all considerations science maintains its rights and does not cease to impose its duties."

THE twenty-third annual meeting of the Optical Society of America will be held on October 27, 28 and 29 at the General Brock Hotel, Niagara Falls, Canada. In addition to the usual program of papers the meeting will include a symposium on the "Optics of Illumination," in which it is planned to include invited papers on terminology and standards, basic principles of illumination, widely used light sources and recent developments in light sources; a popular lecture by Robert McMath, director of the McMath-Hulbert Observatory of the University of Michigan, illustrated with astronomical motion pictures, including spectroheliographs of solar prominences; visits to the University of Buffalo, the Spencer Lens Company, the Cyanamid Plant, the Queenstown Power House, the Whirlpool, the Welland Ship Canal and the Locks at Thorold. The meeting will be open to non-members as well as members of the society. Non-members, who desire to receive the advance program, final notices or other information in regard to the meeting, should address their requests to the secretary not later than October 10.

DISCUSSION

AN ALGONKIAN JELLYFISH FROM THE GRAND CANYON OF THE COLORADO

During the field study of the Algonkian formations in the Grand Canyon of the Colorado River, one of my field assistants, Mr. C. E. Van Gundy, then a graduate student at the University of California, discovered a well-preserved imprint of a jellyfish in the red sandstones above the great lava sequence which forms the top of the Unkar (lower) division of the Algonkian Grand Canyon series. The jellyfish is above 18 centimeters in major diameter. The specimen was submitted to Dr. R. S. Bassler, of the United States National Museum, who identified it. Later a detailed description will be published. The specimen was exhibited at the annual meeting of the Carnegie Institution in Washington in December, 1937, and will be deposited permanently in the National Museum.

Our studies indicate that the Grand Canyon region was under ocean water at least during a part of early Algonkian (Unkar) time when the lower limestones and some of the clastic sediments were laid down. Toward the close of this epoch, emergence took place, and, upon a land surface which probably stood close to sea level, fluvial sediments were deposited as broad flood plains. The latest event of the Unkar was the opening of fissures, the intrusion of diabasic dikes and sills, and the eruption of about a thousand feet of basalt flows. At the top of the lavas is an erosion surface, which sank below sea level and was buried beneath about 400 feet of red sands and clays; between two of the sand layers, the jellyfish was buried. This sequence has a disconformity above and below, and consequently has been set apart as a new group of Van Gundy[1]; to it the name Nankoweap has been applied. After deposition of these strata, elevation above sea level again occurred, and erosion developed a very even surface plain. Later depression below sea level for a long period was marked by deposition of the Upper Algonkian (Chuar) beds, more than 5,000 feet thick. Algonkian history in the Grand Canyon region was closed by folding and faulting, which built the Grand Canyon Mountains. Erosion accompanying and following this orogeny evolved the Ep-Algonkian peneplain, which remained above the ocean until late Lower or early Middle Cambrian time. During this erosion interval, great volumes of Algonkian strata were removed and, over considerable areas, the whole thickness of more than 12,000 feet was swept away, and the Archean basement below suffered some denudation.

The jellyfish is the only authenticated animal fossil which has been found in the Grand Canyon Algonkian. Walcott[2] in 1886 reported the finding of certain fossils "midway of the lower portion of the shales and limestones" of the Chuar group—"a minute Discinoid or Patelloid shell, a small, Lingula-like shell, a species of Hyolithes, and a fragment of what appears to have been the pleural lobe of the segment of a trilobite belonging to a genus allied to the genera Olenellus, Olenoides or Paradoxides. There is also an obscure Stromatopora-like form that may or may not be organic." In 1899, Walcott[3] described and figured these forms. The discinoid shell was named *Chuaria circularis*, nov. g., and sp. The obscure remnant of a brachiopod shell resembles the Cambrian genus Acrothele. The identification of the Hyolithes was questioned, since the specimen possibly may be an inorganic marking. Doubt also was expressed regarding the identification of the trilobite fragment. The Stromatopora-like form was submitted to Sir William Dawson, who was not certain of its organic origin; none the less he gave it the name "Cryptozooan"? occidentale. I have not examined the specimens figured by Walcott, but the illustrations strongly suggest the multitude of inorganic markings to be found throughout the Grand Canyon series. Re-examination of these specimens must be made to prove their organic origin; certainly the existing descriptions do not prove it. My assistants and I have carefully searched the various zones in this great sequence without making other finds. This scantiness of fossils has long been known and is in keeping with that characteristic of Algonkian beds elsewhere in the world. The explanation of this of course has been debated by geologists and paleontologists. Some have accepted Walcott's opinion that the continents stood above sea level during the great length of Algonkian time and that the sediments were accumulated in fresh-water lakes of huge size situated at a considerable distance from the margins of the continents. In these lakes was relatively little animal life. This view is not in accordance with the testimony of the sediments, for Barrell[4] has shown that many horizons of the Belt series of northern United States and southern Canada and of the Grand Canyon series strongly indicate deposition below sea level. My detailed studies at the Grand Canyon and some acquaintance with the Belt series, the Apache group of southern Arizona and the unnamed Algonkian series of southeastern California support Barrell's findings. The hypothesis originally advanced by Brooks[5] and recently modified and expanded by Raymond[6] seems a much more reasonable explanation of the paucity of fossils. These authorities and others hold that animals developed a lime- or silica-secreting mechanism for the generation of resistant parts relatively late in their evolution and that this had not taken place in most forms by Algonkian time. Even in the early and middle Cambrian, the secretions were mostly of chitin, but by the late Cambrian many forms developed structures of calcium carbonate and silica. Raymond holds that most pre-Cambrian animals were motile, swimming or crawling forms, lacking in hard parts. Predaceous carnivores apparently were scarce, hence, "the swimming and floating organisms must have increased rapidly until there came a time when the upper, sunlit part of the oceans was over-populated. This would force some individuals to the bottom. . . . Those animals which reached the bottom near the shore, where the waters were shallow, found abundant food, and survived. . . . Active animals reaching the bottom continued to swim, or learned to crawl after food. The more passive forms adhered to the substratum, became relatively inactive, and began the secretion of skeletons because they were no longer able to get rid of the calcium carbonate. . . . Animals had only commenced to discover the bottom in early Cambrian times." Thus it is probable that the Algonkian oceans were teeming with life when they spread over northern Arizona, but most of the animals, being composed only of soft tissue, left no record. Strange it is that a jelly-fish, one of the most perishable of animals, should have left the only imprint so far discovered. Many fossils doubtless are present in the great mass of sediments deposited in the Grand Canyon region, but so widely scattered are they that great masses of rock may be examined without finding any. Search in the Algonkian Apache beds of southern Arizona, probably correlative with the Unkar strata at Grand Canyon, so far has not yielded any animal fossils.

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[1] C. E. Van Gundy, *Proceedings Geol. Soc. America*, 1936, p. 304, 1937.

[2] C. D. Walcott, Second contribution to the studies of the Cambrian of North America, *U. S. Geol. Surv. Bull.*, 30, p. 43, 1886.

[3] C. D. Walcott, *Bull. Geol. Soc. America*, 10: 232–235, 1899.

In the lower Unkar and especially in the Chuar group, are many limestones which exhibit the structures commonly described as of algal origin. Some of these probably are inorganic, but many of them seem without question to represent algal secretions. The number of such horizons indicates that, at various times at least, the seas were heavily populated with these primitive plants. Most of the limestones probably are marine, but there is the possibility that some may have been accumulated in fresh-water lakes existing on the flood-plains when the land was above sea level. A detailed study of the considerable variety of these structures in the Grand Canyon Algonkian would be a material contribution to pre-Cambrian paleontology. There is no record of any higher types of plants.

Another indication of the abundance of life during Chuar (later Algonkian) time is the great volume of carbonaceous shale and the smaller quantity of carbonaceous and bituminous limestone. Examination of much of this material which I collected has not yielded any actual fossils. Some of the limestones are so strongly bituminous as to emit a very distinct fetid odor when broken.

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A RAINBOW AT NIGHT

I WOULD hesitate to record so trifling an observation as I recently made, were it not for the fact that none of my scientific friends with whom I have spoken seem to be aware of the phenomenon. On the night of June 16, 1938, I observed a rainbow caused by the moon, then only three or four days beyond its full stage. I was crossing from Nassau to Miami on the *Ena-K*, a small motor launch, and was obliged to remain on deck all night. The moon rose about 9 o'clock out of a beautiful calm sea. There was no land in sight. Tumultuous trade wind clouds towered to gigantic heights and there were occasional squalls of rain. About 11 o'clock, when the moon was well up in the southeast sky, the rainbow appeared in the northwest, where a thunderstorm was in progress. The prismatic colors were fairly distinguishable. The arc was complete, the two ends dipping into the sea. At no time was there the least doubt as to the cause of the phenomenon. The conditions were unusually favorable, but probably no more so than at every occurrence of full moon in the trade wind belt, where thunder squalls are common. June is their so-called rainy season for this reason.

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[4] J. Barrell, *Jour. Geol.*, 14: 553–560, 1906.

[5] W. K. Brooks, *Jour. Geol.*, 2: 455–479, 1894.

[6] P. E. Raymond, *Bull. Geol. Soc. America*, 46: 375–391, 1935.

A NEW LOCALITY FOR THE VENUS' FLY-TRAP (DIONAEA MUSCIPULA)

MR. JOHN BOYD, of Southern Pines, N. C., has been so kind as to send me a number of leaves of the Venus' fly-trap (*Dionaea muscipula*) from a locality in the southeastern corner of Moore County, central North Carolina, a station some distance from any previously recorded. Mr. Boyd writes that the traps range in color from maroon to pink and green. The fringes about the edge are maroon, pink or green. The plants are found growing in open beds, apparently having crowded out all other vegetation.

According to Dr. W. C. Coker,[1] this plant has a range more extensive than is generally assumed. He gives stations in Wayne, Lenoir, Jones, Duplin, Onslow, Sampson, Cumberland, Moore, Bladen, Pender, Columbus, New Hanover and Brunswick Counties, North Carolina, and in north and southeast Horry County and eastern Georgetown County, South Carolina. In other words, it ranges from New Bern, North Carolina, to Murrell's Inlet, South Carolina, and westward to Wayne County and two localities in Moore County, North Carolina. It is, however, very local, and the stations at which it occurs are often widely separated.

AUSTIN H. CLARK

U. S. NATIONAL MUSEUM

SCIENTIFIC BOOKS

TRAY AGRICULTURE

Soilless Growth of Plants: Use of Nutrient Solutions, Water, Sand, Cinder, etc. By CARLETON ELLIS and MILLER W. SWANEY. 155 pp., with 59 figures, including 3 color photographs. Reinhold Publishing Corporation, N. Y., 1938. Price, $2.75.

THE National Resources Committee, appointed by President Roosevelt, in reporting last year on the impact of science and invention upon our social and economic life, picked "tray agriculture" as one of the new developments fraught with great future potentialities. This book is welcome because it gives a practical summary of the authors' experience in this promising field, as well as some information selected from the rather scanty literature and experimental bulletins.

It has long been known that some plants, *e.g.*, bulbs which contain their own nutriment, can grow without soil. The well-known hyacinth vases did not enter Omar's mind when he wrote that "every hyacinth the garden wears dropped in her lap from some once lovely head"; but hyacinths, "Chinese lilies" and other plants have been raised in water or on wet pebbles by the hopelessly mid-Victorian housewife. By adding to the water small percentages of potassium, calcium, magnesium, phosphate and nitrate and very minute amounts of the so-called "trace elements," boron, manganese and zinc, we have what the authors term "nutrient solutions," for which a number of detailed formulae are given. By substituting for the flower vases shallow tanks, troughs or trays which may, if one prefers, be filled with sand, pebbles, cinders, etc., and arranging suitable apparatus for continuous or intermittent circulation and aeration of "nutrient solution," we have, according to size, a household or an industrial "plant" for raising plants without soil—by aqua-culture, water-culture, tray agriculture, tank farming or (as suggested by W. F. Gericke in SCIENCE, 85: 177, 1937) hydroponics.[1]

Following a brief Foreword and Introduction, Chapter I discusses the chemistry of plant life; Chapter II, growth in mineral aggregates (sand culture and sub-irrigation methods); Chapter III, growth in nutrient solutions (which are here discussed); Chapter IV, household plant culture (flowers and vegetables); Chapter V, commercial aspects, with some striking photographs of large installations and their results, as well as reference to tanks adaptable to automobile trailers and to ocean-going vessels on long voyages; Chapter VI, special chemicals, including plant "hormones," auxins, colchicine[2] (for chromosome doubling), ethylene, ethylene chlorhydrin (*e.g.*, to shorten the dormancy period in potatoes), thiourea (to improve germination), heavy water; Chapter VII, common detriments, including soil diseases, chemical deficiencies, parasites ("animal, vegetable and bacterial"); Chapter VIII, eight nutrient formulas, with comments.

In the Introduction the authors state that they present "a concise and non-technical discussion of the chemistry of plant life and a review of the three recognized modifications of ***soilless growth***, namely, ***water-culture, sand-culture*** and ***sub-irrigation systems***. Numerous household experiments have been included, liberally supplemented by photographs, which may serve to enable the reader to carry on soilless growth experiments at home for the purpose of producing vegetables and flowers for the family. . . . Accounts are given of a number of large-scale soilless-growth operations. . . . Finally, the authors have attempted to repudiate some of the widely circulated, but erroneous, claims made for soilless-growth practices. The reader is warned that plants grown without soil need attention just as do those grown in soil."

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[1] *Jour. Elisha Mitchell Sci. Soc.*, Vol. 43, Nos. 3 and 4, July, 1928, pp. 221–228, map, pl. 33.

[1] Professor Gericke (University of California) credits Knop (1859) for early experiments in this field and states: "In the late summer of 1935 a number of large growers of certain vegetables and flowers adopted liquid culture media on a large scale for the growing of crops and have (for two seasons) placed on the market products so grown to compete with those produced by agriculture."

[2] The extreme care necessary in handling this highly toxic alkaloid has been recently stressed, and should be referred to here.

With a book intended for popular use, extreme care in the choice of terms must be exercised in order that what is written be scientifically accurate as well as simply stated. In courting simplicity, the authors have been led into some statements that will make scientific readers wince. For example, in speaking (p. 12) of "innumerable tiny pores on the under side of the foliage" they say: "On the proper functioning of these infinitesimal stomata and the microscopic cells within the leaves the entire life of the earth is dependent. For without proper breathing of the stomata the production of the entire food supply of all plants and animals would cease." (How about the evolutionary precursors of plants with foliage? And the authors quote the work of the N. J. Agricultural Experiment Station (New Brunswick, N. J.) where Dr. Selman Waksman has done so much work on the autotrophic bacteria). Page 15: "*Cells?* What are they? . . . They differ in size among plants, but are all formed in more or less the same way, and all serve the same purpose." (The differentiation of cells should at least have been mentioned.) Page 21: "In soil farming the purpose of plowing is to break the soil's upper crust and allow better circulation of air among the roots to take place." (Agriculturists recognize many other benefits, *e.g.*, plowing under of nutrient salts which migrate upward as noted on page 94.) Page 36: An important factor in the accumulation of solar heat in glass-covered containers is the penetration of the glass by the short-length incoming radiation and the impounding of the re-radiated longer heat waves which can not so readily pass out, although "cooling by evaporation of water," mentioned by the authors, is also to be reckoned with. Page 54: In discussing pH, a distinction ought to be made between the *total* acidity or alkalinity of a substance, and the *mobilized* acidity or alkalinity represented by the hydrogen ion concentration. The pH of human blood oscillates about 7.45, and even a few tenths of a unit may mean illness or death. Page 140: Algae are not fungi, nor do they arise from fungi. (Among the parasites, no mention is made of viruses or mosaics.)

All told, however, the authors have presented an interesting and useful résumé in an important new field. They are to be congratulated on the warning they give against high-pressure salesmen who try to sell equipment for this work under promise of miraculous results. They caution against excessive optimism or impatient pessimism. Experimenters are advised to construct their own containers and to use relatively inexpensive commercial grades of chemicals. Under ordinary farming conditions, fertilizing chemicals widely scattered are in part washed away by rain, whereas in hydroponic farming the plants are *protected against rain* so that the nutrient solution is not diluted. The effective utilization of chemicals is higher in tray agriculture, and the onslaught of pests and parasites inhibited or prevented.

It is still to be discovered how soilless growth will affect the quality and viability of seeds thus serially produced; also to what extent the fruits, seeds and plants so grown will carry certain substances (*e.g.*, vitamins, trace elements) needed by animals. From recent work it appears that traces of chromium in forage are essential for sheep and inferentially for other animals too. Possibly impurities in the industrial chemicals will serve to supply such substances, or they may be added. Thus most commercial iron salts contain traces of chromium.

The book is clearly and attractively printed.

Jerome Alexander

SPECIAL ARTICLES

ISOLATION OF A FILTRABLE, TRANSMISSIBLE AGENT WITH "NEUROLYTIC" PROPERTIES FROM TOXOPLASMA-INFECTED TISSUES

A hitherto undescribed disease-producing agent, of especial interest because of its unique properties and origin, was encountered in the course of certain experiments with toxoplasma in mice. These toxoplasma (obligate, intracellular, protozoon parasites of large size[1]) have undergone numerous brain to brain passages in mice in the past three years, and repeated tests revealed that no other agent separable by centrifugation or filtration was involved in the disease they produced. After about the fiftieth passage, however, in an attempt to preserve the toxoplasma at − 80° C. it was found that while they were invariably killed by this procedure, some other agent capable of producing central nervous system disease in mice either became manifest or was liberated in the process. The disease proved to be transmissible by intracerebral injection and the first strain thus isolated has now undergone more than 30 serial passages. At least six other strains obtained in other toxoplasma experiments by freezing or other procedures have been passaged 4 to 12 times. It has proved impossible, thus far, to isolate or demonstrate this transmissible agent in at least two lines of toxoplasma which are being passaged separately in mice.

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[1] A. B. Sabin and P. K. Olitsky, Science, 85: 336, 1937.

The transmissible agent, free from toxoplasma, has the following properties:

(1) It does not multiply in ordinary media with or without blood or ascitic fluid, nor in Noguchi's leptospira and bartonella medium, either aerobically or anaerobically.

(2) After intracerebral injection in mice it produces a characteristic turning on the long axis of the body with or without other nervous signs after an incubation period of 1 to 10 days, but usually on the 2nd to 3rd day. Some of the mice die, some continue with choreiform signs for months, but the majority recover in a few days; some of the latter occasionally relapse. The characteristic lesion consists of an acute necrosis and almost complete dissolution of the caudal pole of the cerebellum (this is the reason for temporarily using the term "neurolytic" to characterize this agent); almost equally frequent is a disintegration of the structures around the lateral ventricles. Neither the meylin nor the axis cylinders are spared in the attack and free fat is formed in the process. A variable number of 21- to 30-day-old mice and the majority of those younger than 15 days or older than 2 months show no signs of disease not because they are immune (for the agent multiplies in them and periventricular lesions are present) but because the cerebellum is not involved.

(3) Nasal instillation with or without ether anesthesia, administration by stomach tube, intracutaneous, subcutaneous, intramuscular, intratesticular and intravenous injections of large amounts of active brain suspension have failed not only to produce any apparent disease or recognizable lesions but also to yield any evidence of local or systemic multiplication.

(4) After intraperitoneal or intrathoracic injection of large amounts about 20 to 40 per cent. of the mice develop convulsions and other nervous signs and almost invariably die, most of them 17 to 48 hours after injection, with an occasional one on the third or fourth day. Definite pathological changes were found only in the nervous system (chiefly the neopallial cortex, basal ganglia, cerebellum and nervous part of the retina) where extensive vacuolization and neuronal degeneration were seen. But while the agent has been found in the liver, spleen, kidneys, adrenals and lungs after intraperitoneal and in the lungs after intrathoracic injection, it could not be demonstrated in the brains of these mice (more than 15 experiments), nor in the peripheral blood either before or after the onset of nervous signs. The failure to find an inhibitor and certain other observations suggest that the brain lesions in these mice were not caused by the agent itself but rather by some non-transmissible substance which is formed when it acts on certain types of cells, or by some as yet inconceivable mechanism. After injection into the vitreous of the eye the agent undergoes marked multiplication, but nervous signs were observed in only 1 of 50 mice and that within 16 to 17 hours after inoculation before any appreciable multiplication is apparent.

(5) One intracerebral injection, whether or not it gives rise to clinical signs, renders mice immune to reinoculation by the same route. Their serum, however, contains no neutralizing antibodies; nor were any antibodies found in the blood of normal mice of various ages. Mice which have had one eye almost completely destroyed by the first inoculation are not immune to reinoculation in the other eye.

(6) The neurolytic agent does not so far appear to possess any definite pathogenic properties in rabbits, guinea-pigs, rats and *rhesus* monkeys.

(7) It keeps for months frozen at − 80° C. and also after being dried *in vacuo* in the Flosdorff-Mudd apparatus; it remained infective after one month in 50 per cent. buffered glycerol.

(8) An infected mouse brain may contain 1 to 2 million minimal doses, and this amount is not appreciably diminished when a suspension in broth is spun at about 2,000 r.p.m. for 1 hour on a horizontal centrifuge; most of it, however, can be sedimented by spinning for ½ hour at 15,000 r.p.m. on an air-driven angle centrifuge. It could be filtered through Berkefeld V candles and it passed a 720 but not a 628 mμ gradocol membrane suggesting that the size of the smallest particle might be in the range of 314 to 360 mμ. Nevertheless, early attempts to visualize the agent microscopically were unsuccessful. After intraocular injection, however, films of the inner contents of the eye, stained with Giemsa or Wright's stain, constantly revealed peculiar minute structures, staining like the nuclear chromatin, which for the most part appeared in the form of rings or ovals with more intense staining at the poles and occasionally also in the form of larger rings or triangles, quadrangles or still other orientation in which a number of "elementary bodies" appeared to be linked by thinner intervening bonds. These structures were not seen in films stained by Gram's method, safranin, carbol-fuchsin, Ziehl-Neelsen or Abbott's spore stain, or after Cesares-Gil mordanting and counterstaining with carbol-fuchsin or methylene blue. Victoria blue stained them satisfactorily. With Rivers' modification of Castaneda's method staining was poor chiefly because the structures did not appear blue as do Rickettsiae or the elementary bodies of psittacosis, but faintly pink (or purplish depending on the differentiation) like the nuclear chromatin. They could not be visualized in the fresh state in ordinary light, while with the dark-field microscope only the

more unique forms could be discerned with any degree of certainty. The same structures were found free and in association with cells in films of the serous surfaces of the liver, spleen, omentum, lungs and heart of mice succumbing after intraperitoneal inoculation while films prepared in the customary way of the transverse sections of these organs usually revealed nothing. They are difficult to find or identify in brain films.

(9) The neurolytic agent has a lower thermal death point (42–45° C. for 15 minutes) than is known for either pathogenic bacteria or mammalian viruses. Toxoplasma, under similar conditions, were not all killed at 45° C. for one half hour.

Tests with several thousand mice (inoculated with brain, blood or viscera or with normal broth) failed to reveal the presence of the neurolytic agent in the normal stock at the time that it was being isolated from the toxoplasma-infected tissues, nor has it been encountered among thousands of other mice of the same stock used in other experiments in the past three years. Furthermore, the properties of the agent are such that one can not at present conceive how it could possibly be transmitted naturally from mouse to mouse either by itself or through any insect vector. Experiments are still in progress on the possibility of a relationship between the neurolytic agent and toxoplasma, but any ultimate decision on its genesis, if that should ever be possible, must be postponed until further opportunity is given other investigators as well as ourselves to determine whether or not it may occur spontaneously in mice under conditions other than infection with toxoplasma.

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INTERCELLULAR WOUND HORMONES PRODUCED BY HETEROAUXIN

We have published investigations indicating that yeast[1] and animal tissue cells[2] injured by ultra-violet light and other means produce wound hormones which stimulate cellular proliferation. In the case of the wound hormone from yeast, we have been able to show that it probably contains adenine, guanine, pentose, phosphoric acid and possibly nicotinic acid, but not proteins or sulfur, and that it is thus similar to, but not identical with, coenzyme.[3]

Leonian and Lilly[4] concluded from their investigations of the action of heteroauxin on various fungi, algae, etc., that it is a growth inhibitor rather than a growth promoter and that in instances in which it stimulates growth, its action is that of an irritant, leading to the increased production of growth substances by the plant cells.

We have studied the effect of heteroauxin on yeast, using the techniques employed in our wound-hormone experiments.[5] It was found to be toxic throughout a wide range of concentrations, and when yeast was subjected to it in toxic concentrations, wound hormones were produced.

In the toxicity determinations, methylene blue staining was used as a criterion of cell injury. *S. cerevisiae* standing in isotonic salt solutions containing heteroauxin in concentrations from 1 : 1000 to 1 : 100,000 showed an increasingly greater percentage of stained cells throughout the period of standing as compared with controls.

In the wound hormone experiments, suspensions of yeast at a concentration of 50 g per L. (wet weight) in isotonic salt solution were divided into two portions, to one of which heteroauxin was added in a concentration of 1 : 1000. After the suspensions had stood for 24 hours, heteroauxin was added in like concentration to the control suspension, both suspensions were centrifuged and the cell-free supernatant fluids were decanted and taken to dryness. These materials were made up in distilled water to approximately ten times their original concentration in the supernatant fluids, and tested for growth-promoting effect on yeast grown in rocker tubes for 24 hours.[5] The population densities at the end of this period were determined by a photoelectric method.[6] Heteroauxin alone, in the same range of concentrations in which it occurred in the yeast fluids, was added to a portion of the rocker tubes in each experiment.

The tubes to which heteroauxin alone was added showed less growth than controls. Those to which fluid from yeast which had stood with heteroauxin were added showed marked stimulation of growth, while those to which fluid from yeast standing in salt solution only was added showed little or no stimulation, depending upon the concentration of heteroauxin introduced with the fluid.

Separate experiments in which heteroauxin was added to rocker tubes in concentrations from 1 : 10 to 1 : 1,000,000 showed depression of growth except for some slight evidence of stimulation in the range near

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[1] Fardon, Norris, Loofbourow and Ruddy, *Nature*, 139: 589, 1937; Sperti, Loofbourow and Dwyer, *Studies Inst. Divi Thomae*, 1: 163, 1937; Sperti, Loofbourow and Dwyer, *Nature*, 140: 643, 1937.

[2] Sperti, Loofbourow and Lane, Science, 83: 611, 1937; Loofbourow, Cueto and Lane, in publication.

[3] Cook, Loofbourow and Stimson, Tenth International Congress of Chemistry, Rome, Italy, May, 1938.

[4] Leonian and Lilly, *American Jour. Botany*, 24: 135, 1937.

[5] Loofbourow, Dwyer and Morgan, *Studies Inst. Divi Thomae*, in publication.

[6] Loofbourow and Dwyer, *Studies Inst. Divi Thomae*, in publication.

1: 10,000. Since the rocker tube concentrations in the wound-hormone experiments were all above this range, and showed stimulation of a higher order, the stimulation obtained in these experiments can not be accounted for by the direct effect of heteroauxin on the yeast in the rocker tubes.

It is concluded that the effect of heteroauxin on yeast is consistent with the mode of action suggested by Leonian and Lilly for its effect on plant tissues.

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CHANGES IN WHEAT METABOLISM CAUSED BY POWDERY MILDEW

INFECTION of wheat with the obligate parasite *Erysiphe graminis tritici* results in a gradual decline in vigor and growth, culminating, in cases of severe infection, in the death of the host. This effect of the mildew is accomplished in spite of the fact that the parasite does not penetrate beyond the epidermal cells, in which large-lobed haustoria are formed. Up to the present time it has not been possible to measure separately the respiration and fermentation of an obligate parasite and that of its host. We have been able to accomplish this, however, in the case of *E. graminis tritici*. By carefully scraping away all the wheat tissue except for the lower epidermis, the latter may be obtained as a strip a single cell thick, with the uninjured mildew attached. Measurements on 5 cm.^{2} of normal epidermis give no respiration within the limits of the apparatus (± 0.05 c. mm O_2/cm^2 surface per hour), while with a similar area of mildewed epidermis the oxygen consumption is 1.3 c. mm per cm^2 surface per hour. On removal of the mildew from the epidermis with a camel's hair brush the oxygen consumption disappears. Thus the oxygen consumption of mildewed epidermis is, within the limits of experimental error, a measure of the mildew respiration. In this way it is possible to distinguish changes which the mildew induces in the host respiration from gross changes in the host-mildew association.

Our experiments were carried out using a Fenn[1] volumetric micro-respirometer, at 22.0° C. Only the first leaf of normal wheat 15 to 25 days old was used. Within these age limits, respiration and fermentation of wheat are fairly constant. Normal wheat was heavily inoculated about 10 days after planting, and the first leaf used for experimental work 7 to 8 days later. The infected wheat was therefore 17 to 18 days old.

Pratt has shown in an article appearing recently[2] that in wheat inoculated with *Erysiphe graminis tritici* there is a rapid rise in the respiration to a value two to three times that of normal wheat of similar age. We have obtained similar results, as may be seen from the data in Table I. In these experiments the respiration of infected wheat was increased 250 per cent. above that of normal wheat. In addition, we have found that if the mildew is removed from the wheat with a camel's hair brush the respiration does not return to the level of uninfected wheat. This conclusion is borne out by measurements of the respiration of mildewed epidermis. One cm.^{2} of infected epidermis consumes only 1.3 c. mm of O_2 per hour, which is much less than the increase in respiration produced in diseased wheat by the mildew (Table I).

TABLE I

Tissue	c. mm O_2	consumed/cm^2	leaf surface/hour	
	1	2	3	Average
Normal epidermis	±.05	±.05	...	..
Mildewed epidermis	1.17	1.61	1.21	1.3
Infected epidermis Mildew removed	±.05	±.05	...	..
Normal wheat ...	1.81	1.67	1.68	1.7
Mildewed wheat .	6.33	5.22	6.46	6.0
Mildewed wheat .	10.7	6.6	...	..
Mildew removed .	7.4	5.4	...	..

Further confirmation of this conclusion was obtained by the use of sodium azide as a poison to differentiate between the respiration of mildew and wheat. A 0.001 molar solution of sodium azide has no appreciable effect on the respiration of normal wheat, but nearly eliminates the respiration of the mildew (Table II).

TABLE II

Tissue	c. mm O_2 consumed/cm^2/hour				Decrease from control value
	1	2	3	Ave.	
Mildew	1.61	1.08	1.21	1.30	
Mildew NaN_3 ..	.18	.13	...	0.15	
Normal wheat .	1.81	1.68	1.67	1.72*	
Mildewed wheat	6.33	5.34	6.46	6.04	
Mildewed wheat 10^{-3} M NaN_3 .	4.45	3.50	...	4.45	1.39

* In this group of experiments no measurements were made of the respiration of normal wheat in azide. In another set, however, the decrease in azide was only 8 per cent.

If the increased respiration due to infection is largely an increase in host respiration, sodium azide should cause a decrease in the oxygen consumption of mildewed wheat which is not greater than that of the mildewed epidermis. As may be seen from Table II, this is actually the case. Although cyanide is just as effective a poison for the respiration of mildew, it is unsatisfactory as a differential poison, since it stimulates wheat respiration.

The fermentation of normal wheat can readily be compared with that of the infected wheat tissue, as

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[1] W. O. Fenn, *Amer. Jour. Physiol.*, 84: 110, 1928.

[2] R. Pratt, SCIENCE, 88: 62, 1938.

mildewed epidermis shows no measurable anaerobic CO_2 production. From Table III it is at once apparent that the infection causes an increase of about 50 per cent. in host fermentation.

TABLE III

Tissue	Anaerobic CO_2 in c. mm			$CO_2/cm^2/hr.$
	1	2	3	Ave.
Normal wheat	1.76	1.80	1.76	1.77
Mildewed wheat ...	2.63	2.70	...	2.67
Mildewed epidermis .	± .03	0.00	± .08	...

The pathogenesis of mildew infection of wheat is correlated with an increase in fermentation and a larger increase in respiration of the host tissue. These changes in the host metabolism occur in the green cells of the mesophyll which are not in contact with, nor invaded by, the hyphae of the mildew. Preliminary measurements of the effect of the disease on photosynthesis indicate that the destruction of functional chlorophyll is subsequent to these changes in fermentation and respiration.

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SCIENTIFIC APPARATUS AND LABORATORY METHODS

A PRACTICAL BELLOWS RECORDER[1]

The Brodie bellows is regarded as one of the most satisfactory recorders of volume changes that we have. Various modifications have been suggested from time to time, but most of them are time-consuming in preparing them for use or they are too complicated to be easily practical. One of the most popular methods of preparing the Brodie bellows is with cargile membrane. This method presents several difficulties. A set of patterns is necessary to cut the membrane. The gluing constitutes the most troublesome feature of the preparation. It usually requires a skilled technician to prepare one that is effectively air-tight. After one has been used once, it requires continuous attention to insure its being available for a second use, *i.e.*, it must be covered with cotton and soaked in glycerin in order to keep it pliable. A few months' use of this instrument together with frequent failure on the part of technicians to prepare one properly led the author to study the problem with the purpose of devising an instrument that would not lose in accuracy and yet be easy to prepare.

The following device was finally arranged and has been in use for some time by the author and many other workers. It consists essentially of a base plate of brass, to which is attached an arm for mounting to an iron support. At the distal end of the mounting arm is a small removable block which is fastened to the base plate by set screws. Through the middle of the base is drilled a hole, which is countersunk from above. A threaded brass tube with a shoulder at one end passes through this hole, the shoulder fitting accurately into the countersunk depression. The bellows fold is made by using either a rubber condom or, with the smaller models, a thin finger cot. If a condom is used, it may be cut off at about one-half length, and with the removable block raised or removed, the condom is placed on the brass plate until the closed end extends a little beyond the free end of the brass plate. Note the position where the threaded tube which passes through the brass plate lies. Mark the point on the condom and cut a small hole in it at that point. Remove the brass tube and inserting its small end first into the condom, push the small end through the hole previously cut. Place a little colophonium cement in the countersunk depression. Warm it gently and then quickly thrust the tube through the hole and immediately tighten the wing nut screwed on the tube beneath the brass plate. Now place the open end of the condom under the brass block and tighten the set screws. The bottom of this block should be covered with a thin piece of soft leather or blotting paper and a similar piece should be laid on the top of the base plate lying under the block. In our laboratory, we have taken a piece of leather from a lady's kid glove and have split a thin layer from it. The object of the leather is to form a padding to grip the condom tightly when the thumb screws in the block are tightened.

All that is left to do now is to fasten the aluminum plate on the top of the condom. This is done by placing one edge of the aluminum plate in the groove in the brass block. With a spot of colophonium cement on the under side of the plate and with *very gentle* traction on the condom, heat the aluminum plate with a metal rod or small flame and push it down firmly against the rubber, holding it until the cement has set. The object of making slight traction on the condom is to insure the edge of the aluminum plate being drawn back snugly into the groove in the brass block when the condom is released. In this way a perfect hinge is formed and wobbling is prevented. On top of the aluminum plate may be fastened any type of writing point—straw, aluminum or celluloid. The length of the writing point may be suited to the needs of the experiment at hand.

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[1] From the Department of Pharmacology, Boston University School of Medicine and the Evans Memorial Hospital.

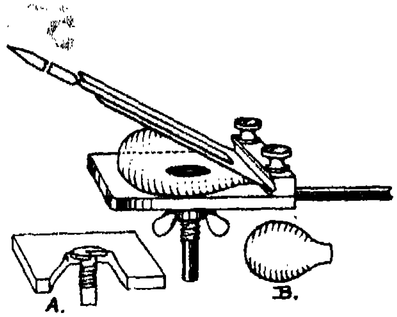

Fig. 1. Bellows recorder.

Fig. 1 is a mechanical drawing of the bellows. Recently we have adopted latex for our balloon material. With this material one can make the balloon any desired shape or size. It is especially desirable to make the balloon smaller in diameter where it passes under the block. Such a shape reduced in size is shown at B in the illustration. At A is a detail drawing of the countersunk depression in the base plate with the brass tube in position. The base plate of the recorder measures 4 cm × 5 cm and is 5 mm thick. It can be made in any shop where tools and a mechanic are available and can be made any desired size. One point indicated in the drawing which might be advantageously changed is the shoulder on the threaded tube which may be made square or, if left round, may be fitted with a tongue which would sink into a corresponding groove in the brass plate. This is to prevent the threaded tube from turning when the wingnut is tightened, thereby skewing the rubber condom somewhat.

This apparatus has been used in several laboratories, and I have been asked many times to publish a description of it. Dr. Charles Gruber, of Jefferson Medical College, Dr. G. H. Miller, of Iowa City Medical School, and Dr. Fredrick F. Yonkman, of Boston University School of Medicine, have used the bellows and published their results. The bellows was demonstrated at the meeting of the American Society for Experimental Pharmacology and Therapeutics held in Rochester, N. Y., in 1927.

Walter L. Mendenhall

"PROPS" FOR COVER GLASSES

A simple method for "propping up" cover glasses in preparing total mounts of chick embryos, small insects and other specimens requiring raised cover glasses makes use of small bone "curtain rings" which are available in ½", ⅝", ¾" and ⅞" diameters, corresponding to standard sizes in round cover glasses.

The bone ring is ground with sandpaper or emery wheel on top and bottom to produce flat adhering surfaces for slide and cover slip. The ground ring is then treated in the same manner as the specimen to be mounted; *i.e.*, washed in distilled water, run through the alcohols, xylol, and impregnated with thin balsam. This procedure is important, especially dehydration, in order that no air or moisture remains in the bony structure to cause "bubbles" or fogging of the balsam after mounting. The rings may be stored in the balsam for later use.

When ready for use, the rings are placed on the slide with sufficient balsam adhering to make a good seal, and then allowed to dry for 24 to 48 hours in a dust-proof cabinet or box. In mounting the specimen, the ring is filled with thick balsam, care being taken to avoid bubbles on the inner and lower periphery of the ring. After placing the specimen in the balsam, more is added until the ring is filled and "heaped" but not overflowing. The cover slip is placed directly over the ring without being pressed down, as the light tension of the cover glass will permit any small bubbles formed to work out and permit some shrinkage of the balsam in drying.

After drying for several days, the ring is "painted" with heavy balsam to form a smooth, even surface finish, and to prevent bubbles of air creeping in as the balsam continues to shrink in drying. An occasional similar application of balsam will make these mounts long-lasting and uniformly neat laboratory slides.

Hertha M. Cordts

New York, N. Y.

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THE AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE

THE SAN DIEGO MEETING OF THE PACIFIC DIVISION

Edited by Professor J. MURRAY LUCK
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THE twenty-second annual meeting of the Pacific Division, American Association for the Advancement of Science, and of twenty associated societies was held in San Diego, California, during the week of June 20, 1938.

It is no exaggeration to describe these meetings as probably the most successful in the history of the division. It may be recalled that the second meeting of the division some twenty-two years ago was held in San Diego with a total registration of 133. Since that time there has been a steady increase in the number of scientific organizations in the Pacific Coast states and of members in attendance upon the annual meetings. As an indication of the growth of interest in science on the Pacific Coast, it should be mentioned that the total registration of 832 members and guests established a new record.

The general sessions and the meetings of the participating societies were held in Balboa Park. The material facilities provided by the host institutions were excellent in every respect. Not only were the buildings in which the sessions were held conveniently grouped together and within easy reach of registration headquarters, but the luxuriant gardens of the park provided a setting of great beauty which added much to the pleasure of the visit in San Diego.

Six organizations joined in sponsoring the meeting and served as hosts to the visiting members and guests: San Diego Society of Natural History, Scripps Institution of Oceanography (La Jolla), San

Diego Museum Association, Zoological Society of San Diego, San Diego State College and the San Diego County Medical Society.

The local arrangements were in charge of a general committee, of which Clinton G. Abbott served as chairman. Not only did many residents of San Diego and its immediate vicinity assist greatly in organizing the meeting through service upon committees, but substantial material aid was extended by the San Diego Convention Bureau.

The first general session was held on the morning of June 21 and consisted of a symposium on "Climate and Man" in which four invited speakers participated. As an introduction to the symposium, "The Present Climate of California" was discussed by Professor John B. Leighly, of the University of California. "Climatic Variations" was the subject of the second address presented by Dr. Ernst Antevs, of Globe, Arizona. Dr. Merrill K. Bennett, of the Food Research Institute, Stanford University, gave an illuminating paper on "Climate and Agriculture," while the concluding address, "Sociological Aspects of Climate," was presented by Professor C. M. Reynolds, of the department of economics, Stanford University.

On the afternoon of the same day a session of considerable interest was held in which the progress of research in several fields was described. Dr. J. A. Anderson, of the Mount Wilson Observatory, Pasadena, described "Recent Instrumental Developments in Astronomy"; H. U. Sverdrup, director of the Scripps Institution of Oceanography (La Jolla), reported on "Recent Advances in Our Knowledge of the Oceans"; Professor C. H. Danforth, of Stanford University, reviewed certain aspects of current research on "The Sex Hormones," and Professor R. Goldschmidt, of the University of California, Berkeley, gave the concluding paper on "Genetics."

Addresses of general interest to the visiting members, as well as to the lay public, were presented on three evenings of the week. The first of these took the form of a symposium on "Animal Experimentation," in which B. O. Raulston, of the University of Southern California, A. J. Carlson, of the University of Chicago, and H. B. Torrey, of Stanford University, participated. The necessity of animal experimentation for future progress in biology and medicine was emphasized in these addresses. Dr. Raulston presented "The Clinical Point of View," Professor Carlson, "The Laboratory Point of View" and Professor Torrey, "The Biologists' Point of View." The subject of this symposium proved to be of considerable interest to the public and very appropriate for consideration at the present time in view of the forthcoming referendum in California upon the so-called "Humane Pound Act," the effect of which would be to render almost impossible the use of dogs and cats for experimental purposes.

Dr. J. S. Plaskett, of the Dominion Astrophysical Observatory, Victoria, B. C., as president of the division, gave the second public address of the week on "Modern Conceptions of the Stellar System." The third and concluding address was presented on June 23 by Professor C. Skottsberg, of the Botanical Garden, Gothenburg, Sweden, on "The Distribution of Flowering Plants over the Pacific Ocean and its Significance."

Among the events of a social character arranged for the entertainment of visiting members and guests, mention should be made of a general reception which was tendered by the host institutions on the afternoon of June 21. This was held in the beautiful gardens of the Court of Honor, Balboa Park. On the afternoon of June 22, tea was served by the San Diego Branch of the American Association of University Women in the Loggia of the House of Hospitality, and again on the afternoon of June 23 in the Fine Arts Gallery by the director and staff.

A number of attractive excursions were arranged, among which mention might be made of those to San Diego Gardens and the Hotel del Coronado, to the San Diego Zoological Gardens, to Point Loma and Old Town, to the Torrey Pines Park and the Scripps Institution of Oceanography, and finally, more extensive trips to Palomar Mountain and the new observatory now under construction by the California Institute of Technology.

Meetings of the executive committee were held daily and of the council on June 22. Dr. S. J. Holmes, professor of zoology at the University of California, Berkeley, was elected to the presidency of the Pacific Division for the ensuing year. H. S. Reed, professor of botany, University of California, Berkeley, was elected to the executive committee in succession to A. R. Davis on completion of the customary five-year term of office. Professor T. G. Thompson, of the University of Washington, Seattle, who had just completed a term of office of three years as a member of the executive committee, was reelected for a full five-year term.

The following eight fellows of the association were elected as members-at-large to serve upon the council: Professor C. H. Thienes, department of pharmacology, University of Southern California (one-year term); Professor E. B. Babcock, department of genetics, University of California, Berkeley (one-year term); Dr. F. J. Veihmeyer, division of irrigation, University of California, Davis (two-year term); Professor C. McLean Fraser, department of zoology, University of British Columbia, Vancouver, B. C. (two-year term); Professor A. P. Krueger, department of bacterial-ogy, University of California, Berkeley, three-year term); Professor Max Mason, department of mathematics, California Institute of Technology, Pasadena (three-year term); Professor C. L. Utterbach, department of physics, University of Washington, Seattle (four-year term), and Dr. H. A. Spoehr, director, Carnegie Institute of Plant Biology, Stanford University (four-year term).

The following resolution on the so-called "Humane Pound Act" was adopted by the council:

> WHEREAS, Our past impressive achievements in the cure and prevention of disease throughout the world have resulted from an intelligent understanding of the functions of the human and animal body in health and disease, and
>
> WHEREAS, The very imperfect advance of our race from savagery and superstition has depended and will continue to depend in no small measure upon a steady increase in our knowledge of the life processes of living beings, both plant and animal, and
>
> WHEREAS, An important part of such knowledge can only be obtained by the actual study of living animals by experimental methods, humanely conducted, and
>
> WHEREAS, An active but misinformed minority of our citizens has persistently refused to recognize the source of these discoveries though ever willing to benefit from them and has continually charged our leading medical and biological authorities with inflicting cruelty upon animals, and has endeavored to hamper these persons by legislation and otherwise, and
>
> WHEREAS, A measure is to be placed upon the ballot next November, and voted upon by the people of California, which purports to be a humane measure, designed to protect from mistreatment animals in public pounds, but whose real effect would be to seriously handicap important and necessary research, and
>
> WHEREAS, The enactment of such legislation would be to greatly retard the progress of biological and medical research in this state,
>
> *Therefore, be it resolved* by the American Association for the Advancement of Science, Pacific Division, assembled in San Diego in June, 1938, that the Division strongly urges the defeat of the so-called "Humane Pound Act" and recommends the employment of widespread publicity calculated to achieve this end.

Announcement was made that the 1939 meeting of the division would be held at Stanford University from June 26 to July 1, 1939, and that of 1940, which will be national in character, will be at the University of Washington, Seattle.

SESSIONS OF THE AFFILIATED SOCIETIES

Twenty of the affiliated and associated societies participated in the meetings and over three hundred papers were presented. The reports of the various sessions follow:

AMERICAN ASSOCIATION OF ECONOMIC ENTOMOLOGISTS, PACIFIC SLOPE BRANCH

(*Report by J. F. Lamiman*)

The Pacific Slope Branch of the American Association of Economic Entomologists held its twenty-third annual meeting on Thursday and Friday, June 23 and 24. During the sessions twenty-two papers were presented. These dealt with a wide range of entomological subjects, including insect toxicology and evaluation of field data.

The entomologists' dinner was held on Thursday evening, and the members were addressed by J. J. Davis and J. A. Hyslop.

The total attendance at the meetings was seventy-two.

The officers elected for 1938 are: *Chairman*, R. H. Smith, University of California at Los Angeles; *Vice-Chairman*, B. G. Thompson, Oregon State College; *Secretary-Treasurer*, J. F. Lamiman, University of California, Davis, California.

AMERICAN CHEMICAL SOCIETY, PACIFIC INTERSECTIONAL DIVISION

(*Report by William G. Young and Dudley H. Robinson*)

The opening session on Wednesday morning was devoted to contributed papers in organic and biological chemistry. Two interesting papers were presented on physical and chemical tests for freshness of fish for food. One group of papers dealt with physiological activity of vitamin C and of vitamin-B_2 analogs and with the synthesis of compounds possessing vitamin-B_2 activity by the pea root. Another group dealt with rearrangements during the synthesis of stereoisomeric compounds.

Wednesday afternoon was given over to an invited group of papers of general interest. Professor A. O. Beckman, of the California Institute of Technology, discussed difficulties encountered in the use of the glass electrode. Professor M. S. Dunn, of the University of California at Los Angeles, presented results on the physical and chemical properties of the amino acids. Professor C. R. Noller, of Stanford University, discussed the structural chemistry of the saponins and sapogenins from the California soap root, while Professor Roger J. Williams, of Oregon State College, summarized his work on the chemical nature of pantothenic acid. Professor Don M. Yost, of the California Institute of Technology, concluded the session with a paper on "Artificial Radioactivity and its Chemical Applications." All the papers were interesting, and an active discussion followed each of them.

The Thursday morning and afternoon sessions were devoted to physical and inorganic chemistry. A number of papers on colloidal and surface chemistry were presented by investigators from Stanford University. An exhibit of several types of inexpensive air-driven ultracentrifuges attracted particular attention. Another group of papers on the determination of molecular structure by x-ray and electron-diffraction methods were presented by investigators from the California Institute of Technology.

Other papers included micro-qualitative analysis of the alkaline earths, polarographic investigations, photochemical oxidation of crotonaldehyde, efficiency of reduction by zinc amalgams and xanthates as collectors in ore flotation.

A dinner for chemists was held on Wednesday evening, and Professors F. O. Koenig, of Stanford University, and H. V. Tartar, of the University of Washington, were elected as members of the executive committee of the Pacific Intersectional Division of the American Chemical Society.

AMERICAN METEOROLOGICAL SOCIETY

(Report by Geo. F. McEwen)

The program of the American Meteorological Society concerned four groups of subjects: (1) Fog, clouds, minimum temperatures and dew points; (2) Weather conditions in relation to forest-fire danger and desert rainfall; (3) Comparative data on Southern California floods based upon official instrumental observations and historical research using old manuscript and published reports; (4) Methods of making upper air observations by means of small portable equipment that can be carried by a pair of sounding balloons. Dynamical treatment of certain upper air observations for calculating the wind velocity at various levels.

Encouraging progress has been made in using not only base station observations but also those from the fine networks of stations in regions of citrus cultivation supplemented by studies of general weather maps, for forecasting minimum temperatures on the afternoon of the preceding day. Methods of forecasting the formation and dissipation of fog and clouds are being developed along quantitative thermodynamical lines using diagrams and tables for facilitating computations. Such results are of special importance to naval operations in the Pacific.

Studies of compilations of numerous observations of wind temperature and humidity and the amount of moisture in inflammable forest material, determined from standard test strips of wood, have made it possible to construct charts invaluable to the forester in efficiently preventing forest fires and in fighting those that do occur.

Studies of available official instrumental observations and older historical records, carefully appraised, indicate several storms in the Los Angeles area comparable with those of February and March, 1938. Certain grossly inaccurate reports have been accepted and recopied as correct, even though a critical study failed to reveal convincing evidence of their correctness. Such research work, leading to tested conclusions and the elimination of unreliable statements, is being continued and should be encouraged.

Remarkable progress, especially since 1930, has been made in developing a small combination of radio transmitter, clock and storage battery, light enough to be carried by a pair of sounding balloons. Thus, essential upper air data on winds, temperature and humidity at heights up to about ten miles can be obtained during nearly all weather conditions and without making aeroplane flights.

Not only instrumental technique has improved but theoretical methods of dealing with upper air data have been developed, enabling the calculation of winds from more or less incomplete observations.

AMERICAN PHYSICAL SOCIETY

(Report by Paul Kirkpatrick)

The Wednesday morning session was devoted to the presentation of brief contributed research reports of theoretical and experimental investigations of the properties of nuclear and cosmic ray particles, phenomena of gaseous ions and certain biophysical phenomena, including the effects of low temperatures upon living cells. This program was followed on Wednesday afternoon by a symposium on "Nuclear Transformations and their Astrophysical Significance," a joint session of the American Physical Society and the Astronomical Society of the Pacific at which W. A. Fowler spoke on "Nuclear Reactions as a Source of Energy," J. R. Oppenheimer upon "The Physical Problem of Stellar Energy" and R. Minkowski upon "The Composition of Stellar Atmospheres."

Contributed research reports constituted the program of the Thursday morning session, with problems of x-ray absorption and electron emission, sound absorption, atomic spectra, gaseous conduction, induced radioactivity and experimental techniques under consideration. The Thursday afternoon program, held at the Scripps Institution of Oceanography, comprised a symposium upon "The Physical Problems of the Ocean," a title comprehending questions of sand movemovement, sedimentary distribution, turbulence and suspension of small particles. This symposium was addressed by H. U. Sverdrup, F. P. Shepard, R. Revelle, W. E. Allen, G. F. McEwen and R. D. Gordon.

The final session, held on Friday morning, consisted of a series of contributed research reports treating the characteristics of certain research instruments (including one for objective determination of photographic graininess), a method for separating radioactive isotopes, emission of electrons under the action of electrostatic fields, variations in liquid viscosities due to flow orientation of molecules and the possible localization of the source of night-sky light in lower regions of the terrestrial atmosphere.

AMERICAN PHYTOPATHOLOGICAL SOCIETY
PACIFIC DIVISION

(Report by L. D. Leach)

The Pacific Division of the American Phytopathological Society held three half-day sessions for the presentation of papers. About forty-five pathologists attended, and twenty-six papers were presented. The first half-day was devoted, mainly, to papers on diseases of citrus, among the most interesting of which were the reports by H. S. Fawcett and L. Klotz on the types and symptoms of psorosis and on its transmission.

The Tuesday afternoon program consisted of a series of papers on virus diseases. Of special interest to those in attendance was the report of Eubanks Carsner on the present status of resistance in sugar beets to curly top disease, that of N. J. Giddings on sugar-beet curly top virus strains, and C. W. Bennett's discussion of the movement of the virus of sugar-beet mosaic.

Other papers that attracted considerable interest were those by C. H. Spiegelberg on the pink disease of pineapple and by L. C. Cochran and Lee M. Hutchins on the host relationships of peach mosaic in Southern California.

Wednesday afternoon was devoted to excursions in the vicinity of San Diego. The largest group visited the Scripps Institution of Oceanography at La Jolla.

A short informal symposium on the teaching of plant pathology was held on Thursday afternoon. The same topic has been suggested for a more elaborate program during the next annual meeting.

Officers elected for the ensuing year are as follows: *President,* W. T. Horne, University of California; *Vice-president,* B. F. Dana, U. S. Department of Agriculture; *Secretary-Treasurer,* L. D. Leach, University of California, Davis; *Councilor,* E. Carsner, U. S. Department of Agriculture.

AMERICAN SOCIETY OF ICHTHYOLOGISTS AND HERPETOLOGISTS, WESTERN DIVISION

(Report by Margaret Storey)

More than twenty members and guests met informally at the laboratory and home of Laurence M. Klauber on Friday afternoon and visited his unsurpassed collection of southwestern rattlesnakes and other herpetological specimens. On Saturday a night desert collecting trip arranged by C. B. Perkins, of the San Diego Zoo, yielded eleven live lizards of two species and twenty-three live snakes of seven species in four hours in the vicinity of The Narrows. In addition, fourteen snakes of ten species and two lizards were observed run over on the road. Some of these were in sufficiently good condition to be saved. The National American Society of Ichthyologists and Herpetologists meeting at Berkeley from July 20 to 23 prevented official participation in the American Association for the Advancement of Science meetings this year.

AMERICAN SOCIETY OF PLANT PHYSIOLOGISTS, WESTERN SECTION

(Report by A. S. Crafts)

The Western Section of the American Society of Plant Physiologists held its third annual meeting from June 21 to 24 at Balboa Park, San Diego. In what was declared by many to be the section's most successful meeting, a full program consisting of three sessions for submitted papers and four joint symposia was presented. Over fifty members registered and all meetings were well attended. Election of F. M. Eaton and J. R. Furr for chairman and vice-chairman, respectively, was announced at an informal dinner on Thursday evening.

The general session on Tuesday morning was devoted to papers on hormones, autonomic exudation cycle, bud inhibition, polarity and other topics involving autonomic responses in plants. This program served to show what rapid progress is being made in relating these complex activities of plants to the auxins and other growth factors.

The Thursday morning session for submitted papers covered topics of horticultural interest, including pest control and soil-plant relations. The Friday morning session provided papers of biochemical and nutritional interest. Of particular merit were reports on methods of study and results with microelements by D. I. Arnon and P. R. Stout. Folke Skoog presented evidence of a relation between zinc deficiency and auxin. These studies, conducted in Professor D. R. Hoagland's laboratory, mark a distinct advance in our knowledge of the function of metals in the nutrition of plants.

Symposia on "Salt Tolerance of Plants and Related Problems," "Plant Invasion on the Pacific Coast," "Cell-Wall Structure" and "Progress in Plant Science" presented cabable reviews in these various fields and emphasized the rapid advancement being made. Of outstanding interest were papers on salt absorption and translocation by D. R. Hoagland and T. C. Broyer, a discussion of the results of studying the plant remains found in adobe brick by G. W. Hendry and J. N. Bowman, papers on cell-wall structure by James Bonner and Wm. S. Stewart, of the California Institute of Technology, and reviews on "Plant Hormones," by F. W. Went, "Permeability," by L. R. Blinks, and "Nature of Viruses," by T. E. Rawlins. The extent to which x-ray analysis, polarized light and radioactive elements from the cyclotron are being used in biology indicates the progressive nature of research in this field of science.

ASSOCIATION OF PACIFIC COAST GEOGRAPHERS

(Report by Peveril Meigs, 3rd)

Fourteen papers, two dinners and two field-excursions marked the sessions of the Association of Pacific Coast Geographers. Thursday morning was devoted to an interesting series of papers on geographic problems of Southern California. Culture and erosion in the valleys and marine terraces were dealt with by R. M. Glendinning and George Carter. Reports on their geomorphologic studies in the San Gabriel Mountains were given by Gordon Oakeshott and Joseph Williams. Williams took challenging but convincing exception to some existing theories of physiographic history of the San Gabriels. Thursday afternoon was given over to a field-excursion led by Alvena Storm dealing with the historical evolution of San Diego. Some of the papers presented on Friday morning were: a survey of North American sand deserts, by Forrest Shreve; a study of the Rio Verde Valley, Arizona, by Agnes Allen; description of Papago villages, by J. W. Hoover; and survey of aboriginal trade routes for sea shells in the southwest, by Donald Brand. An analysis of middens has shown that shells for ornamental purposes had been brought into Arizona and New Mexico in large quantities from the Pacific Coast of Southern California, though the chief source of southwestern shells was the Gulf of California, and a few were brought from the Gulf of Mexico. On Friday afternoon a report by Russell McClure on the Hudson Bay wheat route was read, describing difficulties such as ice, fog and lack of return cargoes, but attaching considerable value to the route as a freight-rate-reducing competitor for Montreal. Peveril Meigs discussed the historical geography of water planning in the Great Central Valley of California, analyzing the changing plans of the past eighty years, culminating in the Central Valley Project now under construction.

At the annual dinner on Friday evening, John B. Leighly gave the presidential address, an analysis of methodologic controversies in nineteenth century German geography. The mystical attitude of Karl Ritter, occupant of the first academic chair ever established in geography, and the gradual breaking-away of geographers from the Ritterian philosophy, leading to the development of modern regional geography, formed the central themes of the address. Saturday was devoted to an all-day field excursion in the foggy coastal desert of Baja California, Mexico, led by Lauren Post and Peveril Meigs.

Officers elected: John B. Leighly, University of California, *president*; Frances M. Earle, University of Washington, *vice-president;* Peveril Meigs, 3rd, State College, Chico, California, *secretary-treasurer;* Otis W. Freeman, College of Education, Cheney, Washington, *editor of Yearbook.*

ASTRONOMICAL SOCIETY OF THE PACIFIC

(*Report by Alfred H. Joy*)

On Wednesday afternoon, June 22, a joint session was held with the American Physical Society with an attendance of one hundred. A symposium on the subject, "Nuclear Transformations and their Astrophysical Significance," was held. The following topics were presented: "Nuclear Reactions as a Source of Energy," by W. A. Fowler, California Institute of Technology; "The Composition of Stellar Atmospheres," by R. Minkowski, Mount Wilson Observatory.

The details of the theory of possible nuclear changes in the lighter elements and the possibility of their application to the interior of stars were considered. On account of the limited observational data available it is difficult to compare proposed theoretical conditions with those prevailing in the stars themselves. Dr. Oppenheimer suggested a model with a high central concentration of neutrons.

Sessions for papers were held on Thursday, June 23, with an attendance of about fifty. An unusually wide range of topics was presented in twenty-nine papers from ten different institutions. They were well distributed in different fields and touched upon the asteroids, the sun, stars, variables, novae, nebulae, interstellar matter and instrumental equipment.

In the papers several points of especial interest were noted. D. M. Beard and Mrs. Kaster reported on determinations of the distance and orbit of the asteroid Hermes, which passed very near the earth in 1937. Mrs. Mulders's study of solar activity indicates that the maximum of the sun-spot curve was probably reached in July, 1937. E. Pettit showed photographs of a prominence which reached the record height of 960,000 miles. A. H. Joy gave the results of his study of galactic rotation based on the radial velocity of Cepheid variables, and H. W. Babcock presented a remarkable curve indicating the rotational velocities in the Andromeda nebula at different distances from the center. A direct determination of the darkening at the limb of an eclipsing star was observed by G. E. Kron with a new photoelectric photometer. The spectra of the two super-novae of 1937 were discussed by R. Minkowski, and F. Zwicky described his plan of search for such objects in the extra-galactic nebulae.

Professor R. T. Crawford, Professor W. T. Skilling and Dr. J. S. Plaskett presided at the various sessions in the absence of President Jeffers.

On Friday, June 24, a party of forty members of the society and their families visited Palomar Mountain and were shown the 200-inch dome and the 18-inch Schmidt telescope by Drs. Anderson and Zwicky and Captain McDowell.

BOTANICAL SOCIETY OF AMERICA, PACIFIC SECTION

(*Report by A. W. Haupt*)

The Botanical Society of America, Pacific Section, held two sessions at which papers were presented, one symposium and two joint symposia with the Western Section of the American Society of Plant Physiologists. At the Tuesday morning session Geo. B. Rigg described a convenient light filter through which plants containing chlorophyll appear red while green paint appears green. H. S. Reed described structural changes in tomato leaves when the plants are grown in nutrient solutions lacking traces of copper or zinc salts. W. E. Allen pointed out that the structural features of certain marine plankton diatoms of the East Pacific are so variable that the identification of species is rendered difficult. Ivan C. Jagger and Thomas W. Whitaker reported on the occurrence of a hybrid between *Lactuca canadensis* and *L. graminifolia*, apparently the first record of an authentic species hybrid in the genus. A paper by Daniel I. Axelrod dealt with the fossil evidence regarding the age and origin of certain California endemics. By request, this paper was read again at the Tuesday afternoon symposium.

On Tuesday afternoon a symposium was held on the "History and Relationships of the Southwestern Flora," in which three invited speakers participated. R. W. Chaney, speaking on plant migrations of late geologic time in relation to modern plant distribution, emphasized that these migrations have been largely from the north, with local and temporary reversals at several times. As a result, many genera have become concentrated in the lower latitudes, others have been eliminated, and still others have survived in modified form. Philip A. Munz gave an illuminating account of endemism in Southern California, discussing the restricted distribution of species in each geographical area. An analysis of the flora of Arizona, showing the proportion of the different geographical elements, prepared by T. H. Kearney and R. H. Peebles, was presented by Mr. Peebles.

At the Thursday morning session, two papers were presented by G. J. Hollenberg, the first dealing with culture studies on the following marine algae from Southern California; *Eisenia arborea*, *Petrospongium rugosum* and *Hapterophycus canaliculatus*. The second paper was devoted to a description of *Amplisiphonia pacifica*, representing a new genus of Rhodomeliaceae.

At a short business session, held on Thursday morning, the following officers were elected for the coming year: *President*, LeRoy Abrams; *Secretary*, Ira L. Wiggins, Stanford University, California.

ECOLOGICAL SOCIETY OF AMERICA

(Report by H. De Forest)

The society held two sessions for the presentation of papers, on the morning and afternoon of Thursday, June 23. It organized two field trips, one for an examination of the trees and shrubs of Balboa Park, conducted by C. I. Jerabek, and one for the bird life, led by J. E. Crouch. It participated also in the Biologists' Dinner of Wednesday evening.

H. P. Hansen had a paper giving an analysis of bogs in the Puget Sound region, based on fossil-pollen studies, in which the post-glacial forest succession was presented. G. D. Pickford, in collaboration with E. H. Reid and L. A. Isaac, described the plant succession in a Douglas fir area of the Pacific Northwest which had undergone cutting, burning and grazing. E. Fritz reported on the accelerated growth of redwood in California after logging. M. W. Talbot, with H. H. Biswell and A. L. Hormay, described the abrupt and pronounced changes in the quantity and composition of the herbaceous annual vegetation in the grassland of the San Joaquin Valley of California. This extensive area contrasts sharply with other major forage regions of the West in its preponderance of annuals and its great abundance of species from the Old World. A. W. Sampson reported on the chemical composition of species as a factor in plant succession in several different plant communities of Central California. C. J. Kraebel and C. H. Gleason gave a paper on the sowing of mustard seed by hand and by airplane for erosion control in burned areas of chaparral in Southern California, reporting upon several ecological aspects of the problem after six years of governmental investigation. W. V. Turnage told of three different methods for determining soil temperature as employed in desert soils. A. G. Vestal discussed problems of the coastal sagebrush scrub and related plant communities—the garigue-like "bush" of Southern California. This was followed by an account of the federal government lysimeter installations in the chaparral scrub of Southern California, for evaluating the water relations of this vegetation, a paper by C. J. Kraebel and E. A. Coleman. Forrest Shreve offered a new classification of life-forms of the Sonoran Desert of North America and made use of a revised form of his map of this desert region. Twenty-five life-forms are recognized, a much larger number than is found in humid regions. Two papers, by C. E. ZoBell and W. E. Allen, and W. E. Allen, treated respectively of the marine phytoplankton near La Jolla, California, and of the offshore diatoms encountered on certain cruises of a research vessel. An increase of the phytoplankton of the sea was usually accompanied or followed by an increase in the bacterial population. The favorable influence of upwelling of ocean waters on diatom production was clearly shown. The greatest abundance of these forms was well away from shore.

SOCIETY FOR EXPERIMENTAL BIOLOGY AND MEDICINE

(Report by C. H. Thienes)

The Pacific Coast and the Southern California branches of the Society for Experimental Biology and Medicine met jointly on the afternoon of June 22. Eight papers were presented. Miles E. Drake, F. S. Modern, John F. Renshaw and C. H. Thienes described experiments by which they showed the post-ganglionic nature of sympathetic fibers and pre-ganglionic nature of the parasympathetic fibers in the mesentery of the intestine. Donald C. Collins discussed the use of papaverine in treating acute arterial embolism. The concentration of blood acetylcholinesterase is normal in diabetic patients and is uninfluenced by insulin or epinephrine, but its concentration is low in hepatic disease, according to A. E. Koehler and Y. J. Katz. Discussing tannic compounds in plants with "little-leaf," H. S. Reed showed lantern slides of the disorganization of plastids and deranged carbohydrate metabolism as a result of zinc deficiency in nutrient media for growing peach and apricot twigs. S. C. Rittenberg and C. E. ZoBell described the use of long "oval tubes" for growing anaerobic bacteria and showed that the oxidation-reduction potential of the media is more important than the quantity of free oxygen present for such organisms. Margaret Gulick Morehouse fed alpha, beta- and beta, gamma-deutero-butyric acid to rats during a period of endogenous ketosis. Twenty-five per cent. of the beta, gamma-compound appeared in the urine as deutero-beta-hydroxybutyric acid, while only 4 per cent. of the alpha, beta-compound was so excreted. A. Goetz and S. S. Goetz reduced yeast cells to −185° and −252° C., at varying rates. Evidence that vitrification resulted from rapid cooling and crystallization from slow cooling was presented. Such vitrification was reversible, with viable organisms recovered, while crystallization was lethal. Thermodynamic considerations were discussed. W. G. Clark observed marked decreases in the intestinal absorption of sodium chloride by adrenalectomized rats.

SOCIETY OF AMERICAN BACTERIOLOGISTS, SOUTHERN CALIFORNIA BRANCH

(Report by Meridian R. Greene)

Papers presented to members of the Southern California section of the Society of American Bacteriologists dealt with a sufficiently varied scope of material to satisfy the interests of those attending the session. Investigations by C. ZoBell, C. Feltham, T. D. Beckwith, E. Geary, C. Fish and R. Tracy pertaining to the metabolic activities of bacteria were reported. Encrustations on the bottoms of vessels increase their running expense; W. F. Whedon spoke on the rôle of marine microorganisms in the formation of a primary film on submerged surfaces. It is to such a film that invertebrates such as barnacles attach. The pathology of Aspergillus infection of penguins was described by L. F. Conti. These fowl were evidently infected in their native habitat, Peru. Fatalities occurred from this fungus a month after capture. Considerable discussion followed the paper of A. Hoyt on immunization of mice infected with the virus of rabies and that of Kessel and Stimpert on the antibody content of the serum of human cases of poliomyelitis, infected monkeys and normal people for neutralizing this virus.

Protection of the public from contaminated eating and drinking utensils is a current problem. Bacterial counts of wash and rinse water occur, not infrequently, in the millions. The best field procedure so far of value to the Los Angeles County Health Department was outlined by R. V. Stone. It includes three requirements: (1) A thermometer for checking the temperature of wash waters which should have a minimum of 120° F. (2) A sediment test for the physical demonstration that the water is dirty. (3) A chlorine test for checking the strength of chlorine rinses which should contain at least 100 p.p.m. A chlorine rinse is essential as hot water heaters usually fail to maintain efficiency during rush periods.

WESTERN SOCIETY OF SOIL SCIENCE

(Report by J. C. Martin)

The Western Society of Soil Science held three half-day sessions at which were presented eighteen submitted papers in addition to a half-day joint session with the Western Section of the American Society of Plant Physiologists. The attendance ranged from forty to sixty persons.

In the opening half-day session the papers presented dealt with soil-profile development as studied in Utah by the Forest Service, soil-erosion studies by the Soil Conservation Service in cooperation with the University of Arizona and with the State College of Washington in which have been developed mathematical expressions of erodibility and in which it has been shown that the forces of perikinetic and orthokinetic coagulation operate in soil suspensions carried by streams. A mathematical expression for the removal of silt by irrigation water in relation to size of stream and slope of ground was proposed from the Utah Agricultural College. The importance of temperature variations on pressure potentials and rate of water uptake by soil columns with shallow water tables was discussed in the light of studies at the University of California.

During the second half-day the papers presented covered a wider range of soil investigations. Evidence pointing to the indispensability of iodine as a plant nutrient was offered from work done in Oregon; the effects of sorghum roots upon subsequent crop growth from the standpoint of their sugar content was discussed in the light of work done in California. In work reported from the University of California, the absorption of potassium from suspensions of clay by excised barley roots was shown to be of some magnitude within a short time period and to be dependent on the degree of saturation of the clay with respect to that ion. The results of two years' work in the examination of leachings from "Russian type" lysimeters at Washington State College show that with annual precipitation of from 20 to 25 inches there has been appreciable leaching, some of which has been lateral in direction, and the magnitude of the nitrification processes has been indicated under different cropping systems. A new apparatus for the study of the effect of "puddling" soil on the binding of the soil moisture as developed at the University of Arizona was described and evidence presented to show that the "bound" water in soils is held, in part, in the form of a thixotropic gel. At the same institution certain correlations were shown between the rate of infiltration of water and the dispersion percentage of soil particles of 0.005 mm diameter.

During the last half-day's presentation of papers on measurement of oxidation-reduction potentials in alkaline calcareous soils as conducted at Arizona and also on the effects of soil-water ratios on the pH measurements in soils as studied at Arizona and the State College of Washington, much lively discussion developed. Microbial activities in the soil as studied at the State College of Washington point to the difference in the nature of the organic residue as being responsible for the development of divergent types of microflora in two important soils in that region. The examination of some typical range soils in Arizona showed the mountain meadows to be much richer in bacterial and actinomyces counts than the forested areas or the desert regions. The occurrence of algae in the soil and their important role in the economy of the soil as studied at Brigham Young University was presented as the closing paper; seasonal variation in the kinds of algae was shown to be evident as was decrease in numbers with depth of soil and with decrease in organic matter content of the soil.

The following officers were elected for the ensuing year: *President,* H. D. Chapman, University of California, Riverside; *Vice-President,* W. T. McGeorge, University of Arizona, Tucson; *Secretary-Treasurer,* J. C. Martin, University of California, Berkeley.

CONCURRENT MEETINGS OF ORGANIZATIONS NOT AFFILIATED WITH THE PACIFIC DIVISION, A.A.A.S.

AMERICAN ASSOCIATION OF PHYSICS TEACHERS

(Report by L. E. Dodd)

This young association, still in its first decade, is one of the newer affiliated societies of the American Association for the Advancement of Science. Appropriate therefore was its convening during the annual June meeting of the Pacific Division, A.A.A.S., its program thereby forming a part of the week's sessions of the larger association.

A luncheon on June 24 in charge of M. S. Allen, Long Beach Junior College, permitted the activities and plans of the American Association of Physics Teachers in the western United States to be discussed informally. Professor D. L. Webster, Stanford University, was called upon, and gave a stimulating impromptu talk. Participating in the discussion was A. A. Knowlton, Reed College, member of the national executive committee.

The afternoon program under the chairmanship of Professor Webster was divided into two parts. In the first group, the following five invited papers were presented: (a) "Equations of State for Physics Teachers," by W. P. Boynton, Oregon State College, Corvallis. He summarized an intensive study, giving a more generalized equation, with lantern slides of models of different thermodynamic surfaces. (b) "The Flying Laboratory," by A. A. Knowlton, which described his experimental study of the cause for an airplane's losing the guiding radio beam. This has been "a contributing factor in a considerable number of all major crashes of transport planes." (c) From the view-point of a high-school teacher, Roy W. McHenry, Escondido, California, discussed "The Physics Problem in High Schools." Four current problems are: lack of material equipment; the recent trend in shortening the time of classes; extremely wide range of abilities among the students, together with their lack of a reasonably adequate mathematical preparation; and the frequent limitations and handicaps of high-school physics teachers. These points aroused lively comments from the audience. (d) Relating the high school to the college, Paul S. Epstein, California Institute of Technology, presented "Mathematics in the Secondary School as Related to College Physics." Professor Epstein's analysis and suggestions were basic and enlightening. His paper, to be published in detail, will surely be read with interest and profit by many. (e) Ernest O. Lawrence, University of California, Berkeley, with outstanding achievements in current experimental research into the atom by means of his invention, the cyclotron, discussed "Relation of the Cyclotron to Present-day Courses in College Physics." Professor Lawrence gave a clear outline of how the present-day teacher should present to students the behavior of electrons in this effective type of modern apparatus.

The second group consisted of seven contributed papers, of which the first was by M. S. Allen, Long Beach Junior College, on "The Evaluation and Guidance of Functional Student Progress." The need for improving the student attitude toward physics was stressed, and suggestions were made as to how this might be done. He urged also helping the student to maintain a balance, by not neglecting development of himself as a well-rounded individual, capable of meeting the larger social requirements. G. G. Kretschmar, Walla Walla College, offered practical suggestions, illustrated by slides, in "A Small Optics Shop as an Aid in Conducting an Intermediate Laboratory Course in Optics." J. L. Bohn and F. H. Nadig, Temple University (introduced by E. C. Watson), described "Hydrodynamic Apparatus for Demonstrations in Radioactivity," giving the necessary equations for the designs, illustrated with slides. Prepared papers read by title because of shortness of time in the one-half-day sessions were: "An Electrical Circuit Containing a Spark Gap," by W. P. Boynton; "An Approach for Introducing the Characteristics of Measurement," by L. E. Dodd; and "An Improved Method for Mapping Electric Fields," by H. C. Burbridge, Fresno State College.

A "Progress Report on the A.A.P.T. 'Manual of Demonstration Experiments,'" written by the editor-in-chief, R. M. Sutton, Haverford College, was read in his absence by a member of the editorial staff for the manual. This up-to-date and comprehensive manual for physics demonstration lecturers will describe about 1,200 experiments, in about 550 pages, with over 400 illustrations. More than 200 teachers contributed material. Having been three years in preparation, it is scheduled to appear in August, from the press of McGraw-Hill. Incidental to this progress report was an exhibit of specimen pages of the manual, selected from the printer's page-proof.

It is expected that most, if not all, of the papers will be published in early forthcoming issues of the association's journal, *The American Physics Teacher*.

The program committee comprised H. A. Kirkpatrick, Occidental College, R. H. Tileston, Pomona College, and L. E. Dodd (chairman), University of California at Los Angeles.

AMERICAN ANTHROPOLOGICAL ASSOCIATION, PACIFIC DIVISION

(*Report by Malcolm J. Rogers*)

The sessions of the American Anthropological Association, which extended over a period of three days, had a daily average attendance of fifty. Eighteen papers in all were read, nine of which dealt with integrating topics which were presented during the symposium on "The Problem of Culture Sequence on the West Coast." This theme was broadened somewhat by papers from adjacent fields. Ernst Antevs presented geological evidence bearing on the antiquity of the Cochise Complex of Arizona and E. B. Sayles the archeological aspects. A summary report on the culture sequence as known in the Nevadan field was presented by M. R. Harrington.

The most recent stratigraphic studies made in California, with a territorial range from Central California to Lower California, disclosed some major agreements and much localized pattern differentiation of a minor nature within the food-gathering horizon. The universal priority of the metate over the mortar was strongly indicated, but Ralph L. Beals, who summarized the symposium papers, was not in accord that the point was proved. In a reconstruction of the cultural prehistory of Southern California, Malcolm Rogers postulated two major horizons, a food-gathering one and an earlier hunting horizon. In connection with the latter horizon he offered evidence for a short chronology to replace the pluvial date which had hitherto been advanced for the appearance of man in California.

In the field of social anthropology, Edwin M. Loeb suggested psychological explanations for conditions obtaining in kin marriage and exogamy, and Peveril Meigs presented unique ethnological data regarding the Kiliwa Indians of Lower California.

VISION IN NATURE AND VISION AIDED BY SCIENCE; SCIENCE AND WARFARE.[1] II

By The Rt. Hon. LORD RAYLEIGH

PRESIDENT OF THE ASSOCIATION

The value to science as well as to daily life of the gelatine dry plate or film can hardly be overestimated. Take, for instance, the generalized principle of relativity, which attempts with considerable success to reduce the main feature of the cosmical process to a geometrical theory. The crucial test requires us to investigate the gravitational bending of light, by photographing the field of stars near the eclipsed sun. For this purpose the gelatine dry plate has been essential: and here, as we have seen, we get into complicated questions of bio-chemistry. This is to my mind a beautiful example of the interdependence of different branches of science and of the disadvantages of undue specialization (or should I say generalization?). We may attempt to reduce the cosmos to the dry bones of a geometrical theory, but in testing the theory we are compelled to have recourse again to the gelatine which we have discarded from the dry bones!

To come back, however, to the development of the photographic retina, as I may call it. As is well known, the eye has maximum sensitivity to the yellow-green of the spectrum, but ordinary silver salts are not sensitive in this region. Their maximum is in the blue or violet, and ranges on through ultra-violet to the x-ray region. It was not at all easy to extend it on the other side through green, yellow and red to infra-red. The story of how this was ultimately attained is one more example in the chapter of accidental clues skilfully followed up which forms the history of this subject.

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[1] Concluding part of the address of the President of the British Association for the Advancement of Science, Cambridge, August, 1938.

In 1873, Dr. Hermann Vogel, of Berlin, noticed that certain collodion plates of English manufacture, which he was using for spectrum photography, recorded the green of the spectrum to which the simple silver salts are practically insensitive. The plates had been coated with a mixture which contained nitrate of uranium, gum, gallic acid and a yellow coloring matter. What the purpose of this coating was is not very obvious. It rather reminds one of medieval medical prescriptions which made up in complexity what they lacked in clear thinking. But Vogel concluded with true scientific insight that it must owe the special property he had discovered to some constituent which absorbs the green of the spectrum more than the blue: for conservation of energy requires that the green should be absorbed if it is to act on the plate. He then tried staining the plate with coralline red, which has an absorption band in the green, with the expected result. With much prescience he says: "I think I am pretty well justified in inferring that we are in a position to render bromide of silver sensitive for any color we choose. Perhaps we may even arrive at this, namely photographing the ultra-red as we have already photographed the ultra-violet." It was, however, half a century before this far-seeing prophecy was fully realized. The development of the aniline color industry gave full scope for experiment, but it has been found by bitter experience that dyes which can produce the color sensitiveness are often fatal to the clean working and keeping qualities of the plate. However, success has been attained, largely by the efforts of Dr. W. H. Mills, of the chemical department of this university, and of Dr. Mees, of the Kodak Company; and we all see the fruits of it in the photographs by lamplight which are often reproduced in the newspapers.

It is now known in what direction the molecular structure of the sensitizing dye must be elaborated in order to push the action further and further into the infra-red, and the point when water becomes opaque has nearly been reached, with great extension of our knowledge of the solar spectrum. The spectra of the major planets have also been extended into the infra-red, and this has given the clue as to the true origin of the mysterious absorption bands due to their atmospheres, which had baffled spectroscopists for more than a generation. These bands have been shown by Wildt to be due to methane or marsh gas. Neptune, for example, has an atmosphere of methane equivalent to 25 miles thickness of the gas under standard conditions. In this Neptunian methane we have a paraffin certainly not of animal or vegetable origin; and I venture in passing to make the suggestion that geologists might usefully take it into consideration in discussing the origin of terrestrial petroleum.

The photographic plate is not the only useful substitute for the human retina. We have another in the photoelectric surface. The history of this discovery is of considerable interest. Heinrich Hertz, in his pioneering investigation of electric waves (1887), made use of the tiny spark which he obtained from his receiving circuit as an indicator. The younger part of my audience must remember that this was before the days of valves and loud speakers. His experiments were done within the walls of one room. When he boxed in the indicating spark so as to shield it from daylight and make it easier to see, he found that this precaution had exactly the opposite effect—the spark became less instead of more conspicuous. To express it shortly and colloquially, this action was found to depend on whether or not the spark of the receiver could see the spark of the oscillator. Moreover, seeing through a glass window would not do. It was ultra-violet light from the active spark that influenced the passive spark. Further, Hertz was able to determine that the action occurred mainly, if not entirely, at the cathode of the passive spark.

The next step was taken by Hallwachs, who showed that is was not necessary to work with the complicated conditions of the spark. He found that a clean zinc plate negatively charged rapidly lost its charge when illuminated by ultra-violet light.

The final important step was in the use of a clean surface of alkali metal *in vacuo* which responds to visible light and passes comparatively large currents. This constitutes the photoelectric cell very much as we now have it, and was due to two German schoolmasters, J. Elster and H. Geitel. English physicists who met them during their visit to Cambridge a generation ago will not fail to have agreeable memories of their single-minded enthusiasm and devoted mutual regard. Sir J. J. Thomson has recalled them to our recollection in his recent book. They could scarcely have foreseen that their work, carried out in a purely academic spirit, would make possible the talking films which give pleasure to untold millions.

The sensitiveness of the dark-adapted eye has often been referred to as one of its most wonderful features; but, under favorable conditions, the sensitivity of a photoelectric surface may even be superior. According to our present ideas, no device conceivable could do more than detect every quantum which fell upon it.

Neither the eye nor the photoelectric surface comes very near to this standard, but it would seem that the falling short is rather in detail than in principle. The action of the photoelectric cell depends on the liberation of an electron by one quantum of incident energy, and under favorable conditions the liberation of one electron can be detected, by an application of the principle of Geiger's counter. The action of the dark-adapted eye depends on the bleaching of the visual purple. According to the results of Dartnell, Goodeve and Lythgoe it appears likely that one quantum can bleach a molecule of this substance, and in all probability this results in the excitation of a nerve fiber, which carries its message to the brain.

The photoelectric cell can be used like the photographic plate at the focus of an astronomical telescope. It might seem from the standpoint of evolution a retrograde step to substitute a single sensitive element for the 137 million such elements in the human eye. In this connection it is interesting to note that in certain invertebrate animals eyes are known which have the character of a single sensitive element, with a lens to concentrate the light upon it. Such an eye can do little more than distinguish light from darkness. But its artificial counterpart using the photoelectric surface has the valuable property that the electric current which indicates that light is falling upon it can be precisely measured, so as to determine the intensity of the light. In contrast with photographic action, the energy available to produce the record comes not from the original source of light, which only, as it were, pulls the trigger, but from the battery in the local circuit, and it may be amplified so as to actuate robust mechanisms. It has been applied with success to guiding a large telescope or, in a humbler sphere, to open doors, or even to catch thieves.

However, the scientific interest lies more in the possibility of accurate measurement. As an interesting example we might take the problem of measuring the apparent diameter of the great nebula in Andromeda. As is known, modern research tends to indicate that the Andromeda nebula and other like systems are the counterparts of the galaxy, being in fact island universes. But until lately there was such a serious difficulty in that all such systems appeared to be considerably smaller than the galaxy. Stebbins and Whitford, by traversing a telescope armed with a photoelectric cell across the nebula, have found that its linear dimensions were twice as great as had been supposed, reducing the discrepancy of size to comparatively little.

But, it may be suggested, could we not go further and make a photoelectric equivalent, not only for the rudimentary kind of eye which has only a single sensitive element, but for the developed mammalian eye which has an enormous number? Could we not build up on separated photoelctric elements a complete and detailed picture? In point of fact this has been done in the development of television; and since this new art which interests us all can properly be considered as an extension of the powers of normal vision, no excuse is needed for devoting some consideration to it. We must divide the photoelectric surface into minute patches which are electrically insulated from one another. This is not too difficult; but if it were proposed directly to imitate nature, and attach a wire, representing a nerve fiber, to each of these patches, so as to connect it to the auxiliary apparatus, we might well despair of the task; for there are probably half a million such connections between the human retina and the brain. In the artificial apparatus for television, one single connection is made to serve, but it is in effect attached to each of the patches in rapid succession by the process of "scanning" the image. The photoelectric mosaic is on one side of a thin mica sheet, and a continuous metal coating on the other side gives the connection, which is by electrostatic induction. Each element of the surface forms a separate tiny condenser with the opposing part of the back plate. Scanning is achieved by rapidly traversing a beam of electrons over the mosaic line by line. The whole surface, and therefore each element, must be scanned at least twenty times a second. In the intervals an element is losing electrons more or less rapidly. The scanning beam comes along, and restores the lost electrons, discharges the little condenser found by the element and the back plate and sends an electric signal into the wire attached to this plate. The strength of this signal will depend on how many electrons the element had lost since the previous scanning, and thus on the luminous intensity of that part of the image. An important point is that the element is in action all the time, and not only while it is being scanned individually. We have thus transmuted the momentary picture into a series of electric pulses occupying in all a time of one twentieth of a second, and these can be amplified and sent out as wireless signals. How are they to be turned back again into a visible picture at the other end? Well, that is not perhaps so difficult as the first conversion of the picture into signals. We must make a beam of electrons follow and imitate the periodic movements of the scanning beam at the other end. The beam of electrons falls on a luminescent screen, and makes it light up, more or less brightly according to the intensity of the electron beam. If we use the incoming signals to modulate the electron beam, we can make them correspond with the intensities at the sending end, and the original picture is reconstructed piece by piece. The reconstruction is completed in one-twentieth of a second or less, and the process begins again. The successive pictures blend into one another as in the cinema, and movement is shown with apparent continuity.

It seems not unlikely that the electric eye or iconoscope, as it has been called, may have applications apart from television. Dr. V. K. Zworykin, who took an important part in its development, suggested that it might be used to make visible the image in the ultra-violet microscope, which would be much too faint for direct projection on a fluorescent screen. For that purpose the sending and receiving apparatus would, of course, be connected directly, without radio transmission. It might also be used for rapid photography, if the photographic plate replaced the viewing screen. The beauty of the device is that the energy is supplied locally, the distant light source merely releasing it. The principle of amplification may thus perhaps be applied to the photographing of faint objects.

I come to the close of this part of my subject.

Much of modern scientific doctrine appears at first sight to have an elusive and even metaphysical character, and this aspect of it seems to make the strongest appeal to many cultivated minds. Yet upon the whole, the main triumphs of science lie in the tangible facts which it has revealed; and it is these which will without doubt endure as a permanent memorial to our epoch. My main thesis has been that these are discovered by methods not essentially different from direct scrutiny. It is hoped that the present survey may remind you that if we allow for a reasonable broadening of the original meaning of the words, it remains true after all that "seeing is believing."

II. SCIENCE AND WARFARE

During the great war itself, few scientific men in any country doubted that it was their duty to do what they could to apply their specialized knowledge to the purposes of war; nor was it often suggested by publicists that there was any countervailing consideration: on the contrary they urged strongly that our resources in this direction should be efficiently mobilized. It is chiefly in vague general discussions that the opposite view becomes vocal.

Science, it is urged, is the source of all the trouble: and we may look to scientific men for some constructive contribution to finding a remedy. It is worth while to inquire what basis there is for this indictment, and whether, in fact, it is feasible for men of science to desist from labors which may have a disastrous outcome, or at any rate to help in guiding other men to use and not to abuse the fruits of those labors. I may say at the outset that I have no sanguine contribution to make. I believe that the whole idea that scientific men are specially responsible is a delusion born of imperfect knowledge of the real course of the process of discovery. Indeed, very much the same complaint was made before the scientific era. Let me refer you to Shakespeare's play of "Henry IV":

> Great pity, so it was
> This villainous saltpetre should be digged
> Out of the bowels of the harmless earth
> Which many a good tall fellow had destroyed
> So cowardly.

The quotation leads us to inquire how far the further development of this particular kind of frightfulness into modern high explosives was deliberate or not.

In the course of systematic study of the chemistry of carbon compounds it was inevitable that the action of nitric acid on substances like benzene, toluene, glycerine, cellulose and the like should be tried. No one could foresee the result. In the case of benzene, we have nitrobenzene, the key to the aniline dye industry. In the case of glycerine, Sobrero obtained in 1846 the highly explosive liquid called nitro-glycerine. He meant no harm, and in fact his discovery lay dormant for many years, until Nobel turned his attention to the matter in 1863, and showed how by mixing nitro-glycerine with other substances, solid explosives could be made which admitted of safe handling. Dynamite was one of them. They proved invaluable in the arts of peace, *e.g.*, in mining and in making railway tunnels, such as those through the Alps. They were used by the Irish Fenians in the dynamite outrages of the eighties. These attempted outrages were not very successful, and so far as I know no one was inclined to blame science for them, any more than for the Gunpowder Plot. Like the latter, they came to be considered slightly comic. If any one doubts this, he may agreeably resolve his doubts by reading R. L. Stevenson's story "The Dynamiter." At all events, high explosives had been too long in use in peaceful industry for their misuse to be laid directly to the account of science.

Coming next to poison gas. We read that Pliny was overwhelmed and killed by sulfur dioxide in the eruption of Vesuvius in A.D. 79. During the Crimean War, the veteran admiral Lord Dundonald urged that the fumes of burning sulfur should be deliberately used in this way, but the suggestion was not adopted. Even if it had been, scientific research *ad hoc* would obviously have had little to do with the matter. During the great war, chlorine was used on a large scale. I need hardly insist that chlorine was not isolated by chemists for this purpose. It was discovered 140 years before, as a step in the inquiry into the nature of common salt.

Coming to the more recondite substances, we may take mustard gas—really a liquid—as typical. It is much more plausible to suggest that here was a scientific devilment, deliberately contrived to cripple and destroy. But what are the real facts?

Referring to Watts's "Dictionary of Chemistry" (edition of 1894), there is an article of less than forty words about mustard gas (under the heading of dichlordiethyl sulfide). After the method of preparation used by Victor Meyer has been mentioned, the substance is dismissed with the words "oil, very poisonous and violently inflames the skin. Difference from diethyl sulfide."

There are sixteen other compounds described at comparable length on the same page. So far as I know, none of them is of any importance. A not uncommon type of critic would probably say that the investigation of them had been useless, the work of unpractical dreamers, who might have been better employed. One of these substances, namely, mustard gas, is quite unexpectedly applied to war, and the production of it is held by the critics to be the work not of dreamers, but of fiends whose activities ought to be suppressed! Finally at the bottom of the page begins a long article on chloroform. This substance, as you know, has relieved a great deal of pain, and on the same principle the investigator who produced it was no doubt an angel of mercy. The trouble is that all the investigators proceeded *in exactly the same spirit*, the spirit, that is, of scientific curiosity, and with no possibility of telling whether the issue of their work would prove them to be fiends or dreamers or angels.

Again, there is the terror of thermite incendiary bombs, spreading fire broadcast through our great cities. The notion is sometimes encountered that thermite was invented for this purpose. Nothing could be further from the truth. I first made acquaintance with it myself in 1901 by hearing a lecture at the Royal Institution by the late Sir William Roberts Austen on "Metals as Fuel."[2] He drew attention to the great amount of energy which was liberated when aluminium combined with oxygen, and showed how aluminium powder mixed with red oxide of iron would react violently with it, withdrawing the oxygen from the iron, and becoming brilliantly incandescent in the process. He showed further how this mixture, called thermite, could be used for heating metal work locally, so as to make welds, *e.g.*, in joining two iron pipes end to end. I venture to say that it never occurred to him or to any of his hearers that thermite had any application in war.

In discussions of this kind a distinction is often implied between what I may call old-fashioned knowledge and modern scientific knowledge. The latter is considered to be the special handmaid of "frightfulness." The futility of this distinction is easily seen by considering a special case. Iron is thought of as belonging to the pre-scientific era, while aluminium is thought to belong to the scientific era. From the standpoint of chemistry both are metals, and the problem of producing them in either case is a chemical one. When produced they both have their function in "frightfulness": iron to cut and stab; aluminium to make thermite bombs to burn and destroy. If modern science makes its contribution to "frightfulness" in giving us aluminium, ancient craft did so in giving us iron. It is obviously absurd to make any distinction in principle between the two cases. Science properly understood includes all real knowledge about material things, whether that knowledge is old or new.

All those terrors have only become applicable against a civilian population by the development of aircraft. Military objects were certainly not the incentive of the successful pioneers of artificial flight. They were fascinated at first by the sport of gliding, and afterwards by a mechanical transport problem.

It is true that brilliant writers of imaginative fiction, such as Jules Verne and H. G. Wells, had foretold all, and more than all, the horrors that have since come to pass. But it is perhaps more to the point to inquire what were the contemporary views of practical men. The Wrights made their first successful flight in 1903. In 1904 I myself heard the then First Sea Lord of the Admiralty repudiate with scorn the suggestion that the Government were interesting themselves in the matter; and I know with equal definiteness that even as late as 1908 the Chief of the Imperial General Staff did not believe in the military importance of flight. Would it be fair then to blame the inventors for not having realized it, and for not having stayed their hands?

Summing up what may be learned from the experience of the past, I think we may say that the application of fundamental discoveries in science to purposes of war is altogether too remote for it to be possible to control such discoveries at the source.

For good or ill, the urge to explore the unknown is deep in the nature of some of us, and it will not be deterred by possible contingent results, which may not be, and generally are not, fully apparent till long after the death of the explorer. The world is ready to accept the gifts of science and to use them for its own purposes. It is difficult to see any sign that it is ready to accept the advice of scientific men as to what those uses should be.

Can we then do nothing? Frankly, I doubt whether we can do much, but there is one thing that may be attempted. The association has under consideration a division for study of the social relations of science which will attempt to bring the steady light of scientific truth to bear on vexed questions. We rejoice to know that our distinguished American visitors are in sympathy with this aim, and we hope that our discussions with them will bear useful if modest fruit in promoting international amity.

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[2] *Proc. R. I.*, February 23, 1901, Vol. xvi, p. 496.

SCIENTIFIC EVENTS

THE BRITISH NON-MAGNETIC ROYAL RESEARCH SHIP

FURTHER particulars of the royal research ship, to be called *The Research*, which is now being built at Dartmouth by Philip and Son, Limited, to the designs of Sir Stanley Goodall, director of naval construction, have been released by the British Admiralty. According to a report in the London *Times*, this vessel is to carry on the international work of investigation performed by *The Carnegie*, of the Carnegie Institution of Washington, which was destroyed by fire at Samoa about nine years ago. The report calls attention to the generous help afforded by the Carnegie Institution in the loan of personnel and the specifications of *The Carnegie* and the instruments used in her.

Although authorized over three years ago, *The Research* is of such an unusual design that her construction has taken much longer than that of a normal ship. She is to cost about £188,500. The principal object in building her is to investigate the problems of the variation of the earth's magnetic field and atmospheric electricity. It is therefore essential that she should be virtually a non-magnetic ship, and the greatest care is being taken to eliminate, as far as possible, all ferrous material from the hull, machinery and stores.

Much research work was carried out by Messrs. Petters at their Yeovil works in order to reduce the quantity of steel in the Diesel engines. A bronze alloy is being used extensively, and the crankshaft is of special non-magnetic steel. Consideration is also being given to such matters as iron nails in packing cases, tin containers for food and cigarettes, cooking utensils, cutlery, razor blades, drums for paint and oil, and even the ship's typewriter, all of which must be non-magnetic.

The hull is being constructed of teak planks on brass frames, subdivided by eight watertight bulkheads. The keel, stem and stern posts are of teak and Canadian rock elm, copper sheathed. Anchors and cables and wire for the rigging will be of aluminum bronze. The ship will have a loaded displacement of 770 tons, and will be rigged as a brigantine, with a full sail area of about 12,000 square feet. The propelling machinery consists of a Petter atomic Diesel engine of 160 B.H.P., driving a two-bladed feathering propeller, and the auxiliary machinery for the dynamos, refrigerator, air compressor and winch includes one 18 h.p. and two 9 h.p. Diesel engines.

The speed will be 6½ knots, and with capacity for 14 tons of Diesel oil the ship will have an endurance of 3,000 miles. Over 20 special scientific instruments will be carried, for while the principal work will be in connection with terrestrial magnetism and atmospheric electricity, the ship will also undertake meteorological work and oceanographical work, for which purposes she will have both observatories and laboratories.

The Research will probably be launched next February and will be ready for her first cruise in October, 1939. The scientific men of the expedition will visit the Carnegie Institution at Washington and, after calling at South American ports, will examine an area in the South Atlantic between Tristan da Cunha and Capetown. When this work is completed *The Research* will make a circuit of the Indian Ocean, probably calling at Perth, Cocos Island, Colombo, Seychelles, Mauritius and Durban, where she should arrive about November, 1940. Her complement will include six officers, four scientific men and twenty-two petty officers and men.

THE FOURTEENTH INTERNATIONAL CONFERENCE ON DOCUMENTATION

THE International Federation for Documentation will hold its fourteenth International Conference on Documentation under the presidency of Sir William Bragg, president of the Royal Society, at Lady Margaret Hall, University of Oxford, from Wednesday morning, September 21, until Sunday, September 25. Afterwards on Monday, September 26, members of the conference will visit the Science Museum, London. Advantage will be taken of the meeting being in England to hold joint sessions on the mornings of Saturday and Sunday with the Association of Special Libraries and Information Bureaus. All those who appreciate the vital importance of the organization of knowledge will realize that the visit of this International Conference to England is an occasion of exceptional moment.

Papers will be read by leading authorities from all countries upon aspects of the following, and other, subjects: Theories of Classification, Cataloguing and Indexing; Methods and Apparatus used in the Organization of Libraries, Archive Repositories, Registering and Filing Centers; Photographic and other Copying Processes in the Application to Bibliographical Problems; The Making of Abstracts from Periodical Literature; possibilities of cooperation—Directories of Information; Exchanges between Publishing Bodies, National and International; The Loan of Books and Documents; principles and possibilities—The Practical Application and Use of Bibliographies. In particular an effort will be made to obtain adequate representation of the varying points of view of workers in diverse fields. At a recent international congress the view was expressed that it was desirable to widen the bases of international bibliography and documentation. At the forthcoming conference a special attempt will be made to secure authoritative reports upon the present state of bibliographical work in such fields of learning as archeology, archive work, economics, history and linguistic studies, in addition to the natural sciences and their applications.

The program will include visits to some of the many interesting places in the neighborhood, together with other social functions. The total cost, exclusive of reports and visits, will not exceed £1 a day.

THE LEVERHULME FELLOWSHIPS

THE Advisory Committee for the Leverhulme Research Fellowships have recommended, and the trustees have approved, the following awards in scientific subjects tenable for varying periods up to two years:

W. Cule Davies, Ph.D., D.Sc., lecturer in chemistry, University College, Cardiff.—Studies of the organic compounds of nitrogen, phosphorus and arsenic.

Mrs. K. A. Esdaile, research worker, London.—A dictionary of English sculptors.

S. Goldstein, M.A., Ph.D., Stokes lecturer in mathematics, University of Cambridge.—The turbulent motion of fluids.

F. C. Happold, Ph.D., D.Sc., senior lecturer in biochemistry, University of Leeds.—The nutrition of the three types of *C. diphtheriae* in its relation to toxin production.

Miss M. W. Jepps, M.A., D.Sc., lecturer in zoology, University of Glasgow.—Studies in the structure and life cycles of certain marine protozoa.

A. King, M.Sc., D.I.C., assistant lecturer, Imperial College of Science and Technology, London.—Leader of expedition to carry out a biological, geological and physical examination of Jan Mayen Island in the Greenland Sea.

D. A. O'Duffy, B.Sc., research and development assistant, Bahrein Petroleum Company.—Lubrication problems at high pressures and temperatures.

O. A. Oeser, M.Sc., D.Phil., Ph.D., lecturer (head of department) in experimental psychology, St. Andrews University.—The "Combined" method in the social sciences.

G. B. B. M. Sutherland, M.A., Ph.D., fellow, lecturer and director of studies in natural sciences, Pembroke College, Cambridge.—The application of infra-red spectra to structural problems in chemistry and physics.

W. Taylor, D.Sc., lecturer in chemistry, the Polytechnic, London.—Substitution mechanisms in aliphatic compounds.

W. H. Thorpe, M.A., Ph.D., fellow and tutor, Jesus College, Cambridge.—The physiology of African Tropical Homoptera.

R. Wilson, M.A., senior lecturer in pure and applied mathematics, University College, Swansea.—The nature and position of the singularities of a function in relation to the coefficient theory of its Taylor series.

SIR RICHARD GREGORY'S LECTURE BEFORE THE CARNEGIE INSTITUTION OF WASHINGTON

THE Carnegie Institution of Washington announces that Sir Richard Gregory, distinguished English scientist, has accepted an invitation to deliver the next Elihu Root lecture at the institution's auditorium, Washington, D. C., on the evening of December 8.

The Elihu Root lecture series, of which this will be the fifth, was established by Carnegie Institution in honor of Mr. Root, who from the founding of the institution to his death in 1937 was a member of the board of trustees and its chairman during the last twenty-four years of his life.

Dedicated as these lectures are to a distinguished scholar widely known for his support of research, they focus attention on the influence of science upon human thought and in shaping attitudes towards life. The most eminent thinkers of the present day, particularly in fields of science, wherever situated, are invited, as opportunity presents, to take place on the roster of speakers.

Sir Richard Gregory has come into position of prominence and of great influence through the books he has written, the addresses he has delivered, and most of all through his brilliant editorship of *Nature*, an English journal which has become an international clearing house for preliminary announcement of scientific researches and results. For forty-five years he has served this journal, first, as assistant editor and, since 1919, as editor. During the period he has contributed to the journal literally thousands of columns of vigorous editorial comment and observation.

In recognition of his public and scientific services Sir Richard was knighted in 1919; in 1931 the hereditary rank of baronet was bestowed upon him. Among the many academic honors accorded him, he was elected a fellow of the Royal Society of London, in 1933, under a special statute reserved for those who "either have rendered conspicuous services to the cause of science, or are such that their election would be of benefit to the Society." Only ten other living fellows of the Royal Society, including Prime Ministers and peers of the realm, have been elected under this provision.

In the forthcoming institution lecture, Sir Richard will discuss "Cultural Contacts of Science." In this address he expects to deal chiefly with the influence that science exerts upon cultural values rather than with the services rendered to modern communities by the utilitarian uses to which scientific knowledge is put.

In the promotion of closer relationship between science and social problems and the progress and use of scientific knowledge in the service of the world of man, Sir Richard sees such contacts contributing not only to the development of social ethics but also to the evolving of spiritual convictions. He regrets that, in general, art and literature have not had their emotions aroused by the achievements of science which represent, he holds, the most wonderful works of man.

The message of science, he declares, is this: that not only the development of man's physical form but also of his ethical standards depends upon himself. He adds: "Man has the power to make the world a celestial dwelling place if he wishes or to reduce it to dust and ashes. He can promote the survival of any type he pleases—poet, philosopher, priest, or pugilist."

Carnegie Institution will publish Sir Richard's lecture in full so that all may obtain a copy who desire to do so.

Frank F. Bunker

RECENT DEATHS AND MEMORIALS

Dr. Otto Hilgard Tittmann, connected with the U. S. Coast and Geodetic Survey since 1867, from 1900 to 1915 as superintendent, died on August 21 at the age of eighty-eight years.

Dr. John Martin Wheeler, professor of ophthalmology at Columbia University and director of the Eye Institute of the Columbia-Presbyterian Medical Center in New York City, died on August 22 at the age of fifty-eight years.

Dr. George Edmund de Schweinitz, professor emeritus of ophthalmology at the Graduate School of Medicine of the University of Pennsylvania, of which he was a trustee, died on August 22 at the age of seventy-nine years.

Darwin M. Andrews, horticulturist of Boulder, Colorado, died on August 14 in his sixty-ninth year. Mr. Andrews was known for his work in the cultivation, selection and improvement of the native plant species of Colorado.

At a meeting of the Osler Club of London on July 12 in honor of the eighty-ninth anniversary of the birth of Sir William Osler, Dr. Archibald Malloch delivered the eleventh Oslerian oration on "Osler." Among those who spoke were Dr. Harvey Cushing and Dr. Charles Singer.

A memorial to the late Professor Hideyo Noguchi and the late Dr. William Alexander Young was formally unveiled by Sir Arnold Hodson, K.C.M.G., on the second of April, 1938, at Accra, Gold Coast, Africa. A representative gathering of the people of Accra was present at the ceremony. Before the memorial was unveiled Dr. David Duff, director of medical services for the Gold Coast, gave a short account of the lives and work of Professor Noguchi and Dr. Young. In his address he stated that, in addition to the memorial, a brass plate, suitably inscribed, would shortly be placed in the room of the Medical Research Institute at Accra, where Noguchi and Young conducted their yellow fever studies.

SCIENTIFIC NOTES AND NEWS

Sir Arthur Eddington was elected president of the International Astronomical Union at the sixth triennial meeting held at Stockholm from August 3 to 10. He succeeds Professor Ernest Esclangon, director of the Paris and Meudon Observatories. The next meeting of the union will be held in Switzerland in 1941.

The election of honorary members of the Royal Society of Edinburgh included, in addition to Dr. Henry Norris Russell, announced in Science last week, Sir Thomas Lewis, physician-in-charge of the department of clinical research, University College Hospital, London, and Professor G. I. Taylor, Yarrow research professor of the Royal Society, fellow of Trinity College, Cambridge.

The gold medal of the Royal Society of Medicine has been awarded to Dr. Wilfred Trotter, director of the Surgical Unit at University College Hospital, London. This was the seventh award of the medal, which is given triennially to a "scientist, man or woman, who has made valuable contributions to the science and art of medicine."

The diploma of honor and medal of scientific merit of the Academy of Sciences and Arts of Rio de Janeiro has been conferred on Dr. B. N. Singh, Kapurthala professor of plant physiology and agricultural botany at the Benares Hindu University; on Dr. B. C. Guha, professor of applied chemistry at the University of Calcutta and honorary director of the department of biochemistry and nutrition of the Indian Institute for Medical Research, Calcutta, and on Dr. H. N. Mukherjee, of the department of biochemistry of Carmichael Medical College. Dr. Guha is known for his researches on vitamins and related subjects and Dr. Mukherjee for his work on insulin and allied themes.

Dr. James B. Murphy, of the Rockefeller Institute for Medical Research, has received the degree of doctor of science from Oglethorpe University, Atlanta.

The honorary doctorate of the University of Cologne has been conferred on Dr. W. L. Bragg, Cavendish professor of experimental physics at the University of Cambridge, formerly director of the National Physical Laboratory.

At a convocation of the University of Oxford on August 11, the vice-chancellor presiding, the honorary degree of doctor of science was conferred on Dr. Charles Gustave Jung, professor of psychology in the University of Zurich. Dr. Jung presided over the tenth International Medical Congress for Psychotherapy, which met in Oxford, this being the first time that the congress has met in an English-speaking country.

Dr. Harry A. Curtis, chief chemical engineer of the Tennessee Valley Authority at Knoxville, has been appointed dean of engineering at the University of Missouri. He will succeed Dr. F. Ellis Johnson, who resigned this summer to become dean of engineering at the University of Wisconsin.

Dr. William I. Myers, professor of farm finance, will return to Cornell University as head of the department of agricultural economics. Dr. Myers has had leave of absence extending to five years, during which he has been governor of the Farm Credit Administration at Washington.

Dr. Julius Lane Wilson, of the Yale University Medical School, has been appointed associate professor of medicine in the School of Medicine of Tulane University.

Dr. Charles A. Shull, professor of plant physiology of the University of Chicago, will be guest professor of the department of botany and plant pathology of the Oklahoma Agricultural and Mechanical College during the autumn semester. He will give an advanced course in plant behavior, and will continue his editorial work on *Plant Physiology* and *The Botanical Gazette*. Dr. W. W. Ray, mycologist, has resigned an instructorship at Cornell University in order to accept an assistant professorship in the department of botany at the Oklahoma Agricultural and Mechanical College.

Dr. Athelston F. Spilhaus, of the College of Engineering of New York University, has been made chairman of the newly established department of meteorology. It is planned to conduct research into factors influencing the weather and to train weather forecasters and observers for air lines, fisheries and other industries. Gardner Emmons, associate meteorologist of the central weather office of the U. S. Weather Bureau in Washington, has been appointed assistant professor. The meteorological observatory at University Heights will house the new department, and research work will be carried on at the Mount Whiteface Observatory, conducted jointly with the Rensselaer Polytechnic Institute on Whiteface Mountain, near Lake Placid.

Dr. J. E. Myers, senior lecturer in chemistry and secretary of the University of Manchester, since 1930 assistant to the vice-chancellor, has been appointed principal of the Manchester College of Technology.

Nature states that a new Institute for Atomic Physics has been inaugurated at the Royal Hungarian University for Technical and Economic Sciences, and Professor Z. Bay, formerly professor of theoretical physics in the University of Szeged, at present director of the Tungsram Research Laboratory of the United Incandescent Lamp and Electrical Company, has been appointed the first professor of atomic physics.

Industrial and Engineering Chemistry reports that Jan Wiertelak, docent in the chemistry of wood at the Polytechnic School in Warsaw, Poland, formerly research student at the U. S. Forest Products Laboratory at Madison, Wis., has been appointed associate professor and head of the Institute for Testing Materials at the Academy of Commerce in Poznań, Poland.

Horace T. Herrick has been appointed an assistant chief of the Bureau of Chemistry and Soils. Mr. Herrick will assume responsibility, on behalf of the Department of Agriculture, for the general direction and coordination of the chemical and chemical engineering investigations of the four regional research laboratories authorized in the Agricultural Adjustment Act of 1938 to conduct researches into and to develop new scientific, chemical and technical uses for farm products and by-products.

Kiril Spiroff has been promoted from assistant curator to curator of the A. E. Seaman Mineralogical Museum of the Michigan College of Mining and Technology.

Dr. G. MacDonald, medical officer in charge of the branch of the Ross Institute for Tropical Research in Ceylon, has been appointed assistant director of the institute and will assist Sir Malcolm Watson in London. Dr. Robert Svensson will take up the appointment in Ceylon. Dr. J. W. Foster, a newly appointed assistant director, will take charge of a new branch of the institute in the Gold Coast at the end of the year.

By an order of the British Committee of Privy Council, made after consultation with the Medical Research Council and with the president of the Royal Society, Dr. C. R. Harington, professor of pathological chemistry, and Dr. W. W. C. Topley, professor of bacteriology and immunology, both of the University of London, have been appointed members of the Medical Research Council, in succession to Professor A. J. Clark and Sir John Ledingham, who retire in rotation on September 30.

Dr. Carl Lucas Alsberg, director of the Giannini Foundation at the University of California, has become a member of the Division of Foreign Relations of the National Research Council.

Dr. C. A. Adams, professor of engineering emeritus of Harvard University and consulting engineer of the Edward G. Budd Manufacturing Company, Philadelphia, and Dr. A. C. Fieldner, chief of the technologic branch of the U. S. Bureau of Mines, Washington, D. C., have been appointed members of the advisory committee of the thirteenth Exposition of Power and Mechanical Engineering to be held at Grand Central Palace, New York City, from December 5 to 10.

Lieutenant-Colonel W. L. Harnett, formerly professor of surgery at the Medical College of Calcutta and recently reader in surgery at the British Postgraduate Medical School, has been appointed medical secretary to the Clinical Cancer Research Committee of the British Empire Cancer Campaign.

Lewis B. Kellum, associate professor of geology, who has a year's leave of absence from the University of Michigan, is directing the exploration program of the Standard Vacuum Oil Company in New Zealand.

The Smithsonian Institution was represented on the recent Presidential cruise aboard the *U. S. S. Houston* by Dr. Waldo L. Schmitt, curator of marine invertebrates of the United States National Museum. Dr. Schmitt recently returned to the museum with considerable zoological, botanical and geological material. Of particular note is a large collection of fish, including a number of rare forms and several species new to the National Collections, secured by the President and members of his party, and series of specimens from seldom visited Clipperton Island.

Dr. Wilfred H. Osgood, chief curator of zoology at the Field Museum of Natural History, returned to Chicago on August 18. Dr. Osgood left on May 15 as the head of an expedition conducted in south central New Mexico. He was accompanied by Dr. Frank W. Gorham, of Los Angeles, and Walter F. Nichols, of Pasadena. The expedition, personally financed by Dr. Osgood as a contributor to the museum, concentrated its efforts chiefly on the "white island" of sand in Tularosa basin, a desert region of some three hundred square miles, and in the adjoining territory where a black lava formation composes the ground surface. Approximately four hundred specimens of mammals, birds and reptiles, including a number of rare and odd species, were collected. In addition, Dr. Osgood obtained important zoological specimens in the Mogollon Mountains of New Mexico, in California and in Colorado.

According to *Nature*, Professor C. D. Ellis, who holds the Wheatstone chair of physics at King's College, London, has been granted leave of absence for the Michaelmas and Lent terms in order to make a tour which has been arranged by the Conference of Canadian Universities. Professor Ellis plans to spend some time, up to a week or ten days, in most of the universities, in order to have ample opportunity for meeting the staff and for discussing matters of interest. He is leaving England in September, and will go first to Vancouver, and will visit Edmonton, Saskatoon, Winnipeg, Ottawa and Montreal before Christmas. Starting again in January, he will visit Hamilton, London, Toronto, Kingston, Quebec, Sackville, Halifax, returning to England at the end of March.

The sixtieth meeting of the American Astronomical Society will be held at the University of Michigan from September 14 to 16, under the presidency of Dr. Robert G. Aitken, director emeritus of the Lick Observatory. The address of welcome will be given by Dr. Alexander G. Ruthven, president of the university. The annual dinner will be held on Friday evening at 7 o'clock at the Michigan Union. On Saturday morning there will be an inspection of the McMath-Hulbert Observatory and of the motion pictures of recent solar prominences, etc. After the close of the meeting an excursion is planned to Henry Ford's Greenfield village.

The autumn meeting of the Electrochemical Society will be held at Rochester, New York, from October 12 to 15. The Hotel Seneca has been selected as headquarters. In addition to the program of technical papers there will be two special symposia. Dr. S. O. Morgan, of the Bell Telephone Laboratories, Summit, N. J., will preside over the symposium on "Plastics in the Electrochemical Industry," in which the speakers and their subjects are: Gordon M. Kline, U. S. Bureau of Standards, "Classification of Commercial Organic Plastics and Their Chemical Properties"; V. E. Meharg, Bakelite Corporation, "Thermosetting Plastics"; S. D. Douglas, Carbide and Carbon Chemicals Corporation, "Vinyl and Styrene Resins"; H. R. Dittmar, E. I. du Pont de Nemours, Inc., "Methacrylate Resins"; Shailer L. Bass, Dow Chemical Company, "Ethyl Cellulose and Styrene Plastics"; W. A. Yager, Bell Telephone Laboratories, "Dielectric Constant and Loss of Plastics as Related to Their Composition"; R. M. Fuoss, General Electric Company, "Electrical Properties of Polyvinyl Chloride Plastics"; Erik Ackerlind, Brooklyn, N. Y., "Dielectric Properties of Shellac." The second symposium will be devoted to "The Metallurgy of Silver." Dr. Lawrence Addicks, of Bel Air, Maryland, will be chairman of this session, to which Dr. F. C. Mathers will contribute two papers, one on silver alloys by deposition, another one on the porosity of silver plate; Dr. Colin G. Fink and V. S. de Marchi will speak on the silver-iron alloy. Dr. D. K. Alpern, of Brooklyn College, also is expected to take part.

Edward K. Love, a real estate dealer of St. Louis, has made a gift of $100,000 for the establishment of a Missouri Wildlife Conservation Foundation, the income to be used for purposes recommended by the State Conservation Commission.

DISCUSSION

THE QUESTION OF A SEASONAL STERILITY AMONG THE ESKIMOS

RECENTLY several references to a winter sterility among the Eskimos have appeared in the literature. This assumed fact has been used by some writers as a confirmation of their findings that the length of the day is influential in determining the breeding season of certain experimental animals. Apparently the support for this view-point rests, to a considerable degree at least, on the report made by Dr. Frederick A. Cook[1] in addressing the New York Obstetrical Society. His intimations that there is a sterility among the northern Greenland Eskimos during the winter months have not been satisfactorily substantiated. Since Dr. Cook has been quoted rather extensively it seems advisable to call attention to certain contradictory evidence based on more carefully collected data and made by observers of wider scientific experience with that Arctic race.

In support for his belief that there is a seasonal sterility among the Eskimos, Dr. Cook, ethnologist to the first Peary North Greenland Expedition, stated, "During the Arctic night the menstrual function is usually suppressed, not more than one woman in ten menstruating." He continued, "During the whole of this long Arctic night the secretions are diminished and the passions suppressed, resulting in great muscular debility. Our own party suffered in the same way." Further support for the existence of a seasonal sexual periodicity lies in his observation that, "The passions of these people are periodical, and their courtship is usually carried on after the return of the sun. . . . Naturally enough, then, the children are usually born at the beginning of the Arctic night, or about nine months from this time." In regard to the age of puberty Dr. Cook stated, "Although these girls attain their size early, they do not menstruate until the age of nineteen or twenty years."

The frequently quoted citation of Ploss[2] to the observation of MacDiarmid that the Eskimos do not menstruate until about the age of twenty-three and then only in the summer months would seem to lend some support to Cook's statements. However, it seems to be generally believed that neither the Eskimo's reckoning of his own age nor the white man's estimate of his age is reliable. Only the ages of those Eskimos whose births were recorded by some responsible agency, missionary or governmental, should be used where scientific accuracy is intended. Certainly no such data on the Polar Eskimos were available to MacDiarmid a century ago.

The above report of Dr. Cook was given considerable publicity a short time ago by Llewellyn,[3] who apparently accepts Cook's view-point without checking his evidence or his qualifications and speaks of the annual recurrence of a "menopause," likening it to a " 'species' of 'hibernation' " localized to the hypophysio-gonadal system. He believes this assumed phenomenon to be due to the lack of sunlight.

On the other hand, there is ample evidence to oppose the statement that the Eskimos generally are sterile in the winter. In his diary for October 17, 1908, Stefansson[4] mentions an Eskimo birth in Arctic North America, indicating a conception in January.

Peter Freuchen, not a casual visitor, but for eighteen years the Danish governor of the Thule colony in northern Greenland—the same region visited by MacDiarmid and Cook—made pertinent observations in a personal conversation with the author. He married a full-blooded Eskimo and raised a family. According to him, there is certainly no apparent decrease in the frequency of menstruation or sexual desire during the winter months. He believes that the chief cause of sexual debility, when present, is probably famine. True, his observations were made many years after those of Cook and still longer after the visit of MacDiarmid with Ross. The population was not quite so purely Eskimo, but there were many of the pure stock left and it is hard to believe that their reproductive biology would have changed in any important respect within a few generations.

Dr. A. Bertelsen,[5] chief of the medical service of Greenland, presents an analysis of the births between 1901 and 1930 in West Greenland. This study of 16,101 births, both legitimate and illegitimate, shows that more conceptions occurred in December and April than in any other months. Conceptions by months, figures adjusted to a basic average of 100 per month, are as follows: January 101, February 101, March 103, April 113, May 106, June 96, July 89, August 85, September 96, October 97, November 100, December 113. The high rate in April lends support to Ellsworth Huntington's "basic animal rhythm," though he does not quote Bertelsen in his recent book.[6] Bertelsen agrees that the high rate for April is due to the return of spring, and feels that the high figure for December is due to the social customs of visiting widely and otherwise celebrating the Christmas season. He finds no influence on conception dates exerted by customary wedding seasons. The low rates of conception in summer are correlated with the high death rates at that time, both of which are probably due to the poorer health existent then. In a series of 127 women in North Greenland the average age of first menstruation was fifteen years and 5 months. In 42 full-blooded Eskimo women the average was fifteen years and 6 months.

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[1] F. A. Cook, *Trans. N. Y. Obstet. Soc.* 1893–1894.

[2] E. M. Weyer, "The Eskimos," p. 48, 1932.

[3] Ll. J. Llewellyn, *Nature*, 129: 868, 1932.

[4] Vilhjalmur Stefansson, Am. Mus. Nat. Hist. Anthropological Papers, 14: 198, 1914.

[5] A. Bertelsen, *Meddelelser om Grønland*, Bd. 117: Nr. 1, 1935.

[6] Ellsworth Huntington, "Season of Birth," 1938.

Apparently Bertelsen had revised his belief in regard to the lack of a seasonal birth distribution, for Birket-Smith[7] quoted him as stating that north of Disko Bay in the Arctic regions proper the number of births increased greatly in the first three months of the year. The same phenomenon also occurred in the two most southerly districts. The statistics given later (Bertelsen, 1935) hardly support these statements.

Dr. Henry Greist, superintendent of the Point Barrow, Alaska, Presbyterian Hospital from 1921 to 1936, furnishes other pertinent information by private correspondence. He writes: "I cannot agree with those who regard the long winter night of the Arctic as inducing physiologically a tendency toward continence. Sexual desire is believed to be as actively manifest during the Arctic night, so called, as during the summer. If any difference at all there is *more* sexual congress during the winter than the summer. . . . Illicit intercourse is far greater in amount during the winter months than within the months of daylight." In regard to the onset of puberty, he agrees with Stefansson[8] that it is quite early in the Eskimo but differs with him as to the cause. Stefansson believes it to be due to the high temperatures maintained in the igloos, but Dr. Greist, in his professional calls, found a very large percentage of the population with no heat much of the time due to lack of fuel. He believes that the lack of privacy on the part of the parents, the crowded homes and the intimate relations on the part of the children lead to early sexual stimulation and that to early puberty. However, the cases of motherhood before fifteen years of age are very rare.

It seems inappropriate to attempt in this brief note any evaluation of the often contradictory evidence in regard to the age of puberty among the Eskimos, except to state the belief that some of the earlier estimates were likely too high. Furthermore, it seems unwise to consider the possibility of the existence of definitely limited seasons of reproduction in other human groups, in regard to which it seems very probable that much of the published material available is based on inadequate data. This paper is merely an attempt to show that there is good reason to believe that Dr. Cook's original observations do not apply to any considerable group of Eskimos and should not be so construed. Regardless of what effect the length of day may have on the reproductive functions of certain experimental animals the Eskimos do not experience a sexual sterility during the long winter night.

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INSECT ZOO AS A WILDLIFE CONSERVATION PROJECT

In September, 1934, there was opened at Goddard Memorial Park, for one experimental month, the Rhode Island Insect Zoo. Its founder and director was Brayton Eddy, national lecturer on entomological subjects. Believing that man will not kill what he appreciates and does not fear, Mr. Eddy undertook to build up an appreciation of insect life by presenting some 150 species alive within environmental display cases which he himself designed. Accompanying the exhibits were descriptive cards giving highlights upon the different species exhibited.

The policy of the insect zoo was to display native insects and animals which feed upon insects, to the end that the general public might be brought to a fuller understanding of the forces operating to promote biological balance. The nature of each animal was defined—whether it was a parasite, predator, scavenger or plant-eater—and the direct effect it might have upon the human race was indicated. In that one experimental month the number of visitors exceeded 30,000 people.

During the summers of 1935 and 1936 the Rhode Island Insect Zoo was considerably enlarged until this summer—when it has been moved to Nooseneck Hill, Rhode Island, under the name Rhode Island Insect Zoo and Nature Center. As a nature center, the exhibit has been augmented by introducing insect-eaters from other states, seasonal wild flowers and local minerals. It has been used to promote pride and appreciation of wildlife and minerals in the hearts of both local visitors and tourists.

The need of something more than government bulletins, photographs, drawings and mounted specimens in getting scientific truths before the general public has long been felt. Insect bulletins tend to pile up on the shelf, gathering dust, while crops are consumed by the very insects they were written to control. How to get the information out of bulletins and offered to the general public in such form that it could be easily grasped was the task to which Mr. Eddy set himself.

He believed that the problem was one of education, but education of a particular kind—education by demonstration. First get the public, then tell your story. The value of live animals in drawing a crowd has long been recognized. Instead of using the crowd as possible purchasers of commercial products, use it as consumers of information on wildlife conservation and insect control problems. Demonstrate the value of calosoma beetles, praying mantes, skunks, crows, snakes and other misunderstood creatures by feeding them in public during certain announced hours of the day.

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[7] Birket-Smith, "Greenland," Vol. II, p. 24, 1928.

[8] Vilhjalmur Stefansson, *Jour. Am. Med. Asn.*, 75: 669–670, 1920.

This is what has been done at the Rhode Island Insect Zoo, and the result has been amazing. People never before interested in small wildlife, or interested only superficially, have come to the insect zoo and spent hours in its perusal. By displaying live examples of the only four types of poisonous snakes in North America, respect and appreciation of all other snakes has been encouraged. By displaying the one species of poisonous lizard in the United States, the same is done for lizards. Local insects lose their horror when the few pain-givers—those which sting and those which cause a rash when handled—are represented by live specimens. Exhibiting the black widow spider and the tarantula, and explaining that they alone—of all spiders in Rhode Island—are dangerously poisonous, the lives of many other harmless and beneficial spiders are being spared.

To-day the insect zoo and nature center has become first port of call for many farmers and gardeners who are suffering from insect and other pests. Specimens are brought in for identification and for comparison with other specimens in the exhibit cases. Questions on insect control are incessant. The statement is repeatedly heard made by the departing visitor, "Well, I won't be killing them any more."

In the eight summer months which the zoo has been in operation, over 600 species of live insects and insect-eaters have been on display. Many more have been identified and added to the type collection of Rhode Island insects which is being kept for scientific reference. Over 105,000 visitors have attended. The zoo is situated twenty-three miles south of Providence, R. I., Route No. 3. It is open daily from 10:00 A.M. to 10:00 P.M. until October 2. The state cooperates in the matter of site and advertising, but leaves it to the fifteen-cent entrance fee to pay running expenses. Its purpose is educational. Members of the American Association for the Advancement of Science are always welcome, particularly if their attitude is critical.

BRAYTON EDDY

REGULAR POLYHEDROIDS

THE readers of SCIENCE may be interested to know that the results in the article by E. R. Bartlam entitled "On the Properties of Rectilinear Figures of n Dimensions" (SCIENCE, July 1) are special cases of those found by Stringham[1] in his exhaustive study. Stringham extended Euler's polyhedral theorem to n-dimensional space and showed that regular self dual $(n+1)$-hedroids analogous to the tetrahedron exist in any n-dimensional Euclidean space and that the number of regular elements of different dimensions, triangles, tetrahedra, etc., which bound these polyhedroids, are given by the expansion of $(1-1)^{n+1}$, excluding the first and last terms.

He showed that dual (2^n)-hedroids and $(2n)$-hedroids analogous to the dual polyhedra, the octahedron and cube, also exist in any n-dimensional Euclidean space and that the number of regular elements of different dimensions, triangles, tetrahedra, etc., or squares, cubes, tesseracts, etc., which bound these polyhedroids are given by the expansion, in direct and reverse order, respectively, of $(2-1)^n$ excluding the last term. Bartlam's table gives special cases of this theorem.

Stringham showed that no other real regular polyhedroids can exist in n-dimensional spaces when $n>4$. In three-dimensional space there are of course in addition the two dual polyhedra, the dodecahedron and the icosahedron.

Stringham finally showed that in four-dimensional space there exist also a self dual (24)-hedroid whose boundaries are regular octahedra, and two dual polyhedroids, a (120)-hedroid with dodecahedral boundaries and a (600)-hedroid with tetrahedral boundaries.

L. B. TUCKERMAN

NATIONAL BUREAU OF STANDARDS

QUOTATIONS

SCIENCE IN PRACTICE AND THEORY

ONE of the prime functions of the annual meetings of the British Association is to serve as a reminder to the nation at large of the basic importance and interest of natural science, alike in its philosophical bearings, its practical results, and its social implications; and the president, in his address, has an unrivalled opportunity of crystallizing this aspect of the association's work. This year's president, Lord Rayleigh, distinguished scientific son of a distinguished scientific father, has taken full advantage of this opportunity, He has discussed not only certain recent advances in pure knowledge and numerous remarkable practical applications of such knowledge, but also some of the ethical problems as well as the philosophical puzzles arising from recent scientific advance. The ethical problem concerns the relation of science in general and the individual scientist in particular to war and the preparations for war. The present time is exceptional in the wide divergence of opinion on the subject. In earlier periods men of science found themselves in no dilemma. In general, either they were not asked to put their knowledge to military use, or, if asked, they did so unquestioningly. The increasing importance of applied science in warfare is now, we see, assisting the virtual conscription of scientific knowledge for military purposes; and the resultant increase in the horrors of war, together with the growing realization of war's futility and wastefulness, has caused new heart-searchings among scientific workers.

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[1] W. I. Stringham, *Am. Jour. Mathematics*, 3: 1, 1–14, March, 1880.

Lord Rayleigh confines himself in the main to pointing out that science can not be blamed for the horrors of war. Those inventions which have made modern warfare more horrible, including mustard gas and incendiary bombs, are almost without exception applications of old scientific discoveries, made with no military objective. As he rightly concludes, science is the outcome of the urge to explore the unknown, and its results can not be divided into sheep and goats. Science is of its nature ethically neutral; what good or evil use is made of its discoveries depends on society at large. The problem remains, however, as to the conduct of individual men of science in putting their knowledge at the service of the war machine. Opinions are bound to differ on this subject. The view accepted by most scientists seems to be that this is a matter of individual conscience just as much as readiness to serve in any other direct or indirect military capacity. It is true that the man of science has greater potentialities for good or evil as a technical adviser than as a private or even as a colonel: but this does not alter the nature of the problem.

There is finally the question whether we can do anything in the matter. Lord Rayleigh is frankly sceptical, but allows a modest ray of hope in the proposal to establish a division of the association for the study of the social relations of science. So far as there are likely to be immediate results, scepticism is undoubtedly justified. But in the long run perhaps a more hopeful view may be taken. The scientific study of human nature, especially in its social aspect, is only in its infancy. As Dr. Glover forcibly pointed out a few years back, the causes of war are at least as much psychological as economic. Repression and frustration in early life engender unconscious cruelty whose natural outlet is violence, and mass suggestibility, under the influence of propaganda, generates an irresistible mass hysteria, a neurosis of society. Theoretically, at least, it is possible to plan a system of education which would allow the natural impulses to be expressed instead of repressed, thus removing the dangerous because unconscious mainspring of violence, and making it possible to harness the deep psychological forces to construction instead of destruction; and one which, instead of fostering suggestibility and material respect for authority as such, would encourage critical reflection and a healthy distrust of propaganda. A society educated thus would be a new kind of society, of its very nature much less inclined to make war than ours. Admittedly this is remote; but is it more remote than was our electric age from the age of Galvani or of Ampère, or even of Faraday? To apply scientific method to the study and control of human nature, new techniques and a new approach are necessary; but there is no reason to suppose that it can not be done, and many reasons for supposing that in doing so lies the world's chief hope of emerging from chaos and frustration.—*The Times, London.*

SCIENTIFIC BOOKS

QUANTUM MECHANICS

The Fundamental Principles of Quantum Mechanics. With Elementary Applications. By EDWIN C. KEMBLE. McGraw-Hill, New York and London, 1937. xviii + 611 pp. $6.00.

THE classical or Hamiltonian dynamics arose from celestial mechanics, especially the study of the motion of the solar system under gravitation. It provided a consistent mathematical system of equations representing these motions very accurately. Exact solutions of these equations can only be obtained in simple cases; and it is still doubtful over how long a period of time the approximate solutions can be applied. There are still unsolved mathematical difficulties involved in the long time solution of the problem of three bodies. Classical electrodynamics arose from physical experiment. It provided a consistent system of equations representing the action of electric and magnetic forces on matter in bulk regarded as generally continuous. It was applied to give a consistent theory of radiation moving with the velocity of light in empty space. Classical statistical mechanics applied classical dynamics to the motion of chemical molecules. There were three principal but not exclusive methods of attempting to surmount the mathematical difficulties; that associated especially with Maxwell, assuming "continuity of path"; that especially due to Boltzmann, using collisions and the H-theorem; and that of Gibbs, using from the beginning an "ensemble" of states taken by the assemblies of molecules with various probabilities. These methods arrived at essentially the same result; that isolated closed systems and systems contained in thermostats would approach a statistical equilibrium in which the general laws of thermodynamics would hold; but they gave, for instance, specific heats disagreeing with observation. "Continuity of path" has only recently been justified by the work of T. M. Cherry, Birkhoff and J. v. Neumann.

With the discovery of the electron came the attempt to apply electrodynamics to the motion of single electrons and statistical mechanics to the motion of assemblies of electrons; leading to the well-known interconnected disagreements with observation in the thermodynamics of radiation and in the processes of emission and absorption of radiation. The attempt to describe the electron itself in terms of its field alone also led to an impasse. Some of these difficulties were met by the introduction of the quantum theory by Planck and Bohr, first in *ad hoc* assumptions about the processes of emission and absorption of radiation and the possible intermediate states of atoms. The methods of statistical mechanics were extended especially by Planck and by Darwin and Fowler. Various theoretical results were verified by observation and new difficulties arose. These led to a new discussion of the nature of our knowledge of atoms by Bohr and Heisenberg and to the introduction by Heisenberg and Dirac of matrix and operator mechanics; and to that of wave mechanics by De Broglie and Schrödinger. It was said even before matrix or wave mechanics were developed that, while the theory of relativity on the one hand dealt with physical problems in which the quantum of action could be regarded as negligibly small, but the time taken by light to pass from one part of the system to another was taken into account, the quantum theory on the other hand dealt with physical problems in which the latter could be neglected, but not the former.

Now the development of quantum mechanics has led to a formulation which seems to be logically complete when the time of passage of light can be neglected. It provides a consistent set of mathematical equations to represent the observable properties of atomic systems. There are no outstanding discrepancies between conclusions drawn from this theory within its range of validity, and observation; while many new phenomena, such as electron diffraction, have been given no other explanation. The observable properties of atoms are generally to some extent of a statistical nature, and the connection between the solutions of the equations and observation requires careful discussion; while the quantum statistical mechanics for assemblies of atoms requires the special foundation provided by J. v. Neumann. Just as in classical dynamics, when three or more bodies are involved, the equations are not exactly soluble, and there still remain mathematical difficulties in their treatment. Indeed, very little certain is known about the solution of the mathematical problem that must be solved to deal with the continuous spectrum in the many body problem. Moreover, in statistical mechanics difficulties like those of classical statistical mechanics remain. Quantum mechanics has been extended to take account of the finite time of propagation of light only in a somewhat tentative way and "quantum electrodynamics," if it is on the right track at all, is far even from providing a consistent set of mathematical equations; while no description of an electron in terms of its field alone has yet proved satisfactory.

Professor Kemble's "Fundamental Principles of Quantum Mechanics" is, in my opinion, an important work likely to be useful both as a reference book for mathematical methods to the research worker and as a text-book for the graduate student of theoretical physics. It covers generally the ground of nonrelativistic quantum-mechanics, which, as stated above, now forms as logically complete and consistent a system as classical dynamics. The manner in which these mathematical equations describe the observable properties of atomic systems are explained, and the most part of the mathematical methods that have been employed to solve the equations are discussed in detail; the foundations are laid for the quantum treatment of statistical mechanics and of the structure of many electron atoms. I think this book is especially good in its clear explanation of the mathematics used in quantum theory and in its accurate statement of the limitations of that mathematics.

In the first two chapters wave mechanics in the Schrödinger form is built up from classical mechanics and selected observational results using the analogy of the relation of physical to geometrical optics, and the statistical interpretation of wave mechanics is explained, finishing up with the uncertainty principle. In the next four chapters a large number of mathematical methods for exact and approximate solution of the wave equation are considered. One-dimensional problems, separable problems in several dimensions, the continuous spectrum, and finally "The Existence and Properties of Solutions of the Many-particle Schrödinger Eigenvalue-Eigenfunction Problem" are dealt with in succession. This part of the book is especially excellent in pointing out how far the mathematics really goes and what is uncertain and unproved; it contains much material that is not to be found collected together, if at all, elsewhere; and forms the exact mathematical background of the theory.

The next three chapters introduce the general theory of operators representing dynamical variables; their properties; and the theory of their measurement. To this part a quotation from the preface applies most directly. "A feature of the present volume on the physical and philosophical side is its consistent emphasis on the operational point of view and on the fundamental importance of Gibbsian assemblages of independent systems in the physical interpretation of the mathematical formalism." While the reviewer is in complete agreement with the second part of this statement, he does not agree so well with the first part. While it is valuable to know how far operational treatment is possible, one must start somewhere; and in many connections an alternative emphasis, stressing, with Norman Campbell, the theory-fact scheme of treatment of measurement, and allowing such ideas at least as probabilities of unmeasured positions in the theory, seems to be much more convenient, especially as, as Professor Kemble admits, in dealing with probability the operational theory presents difficulties, while an hypothesis-fact picture, such as that of Harold Jeffreys or such as the reviewer believes could be made with the aid of the "likelihoods" of R. A. Fisher, seems much simpler. But these are very much matters of opinion, and the difference may be mainly about words.

The next two chapters, ten and eleven, deal with matrix theory and perturbations not involving the time, including a discussion of the variational method. The following chapter is entitled "Quantum Statistical-Mechanics and the Einstein Transition Probabilities." The first part endeavors, in very small compass, to lay the foundations of statistical mechanics, using the methods of J. v. Neumann and directing the arguments towards a proof that, roughly speaking, as in classical mechanics, an assembly of molecules will tend to a state of statistical equilibrium—in classical mechanics such a proof makes use of the H-theorem or of continuity of path; so in quantum theory, a pure state of such an assembly will after some time be indistinguishable from a Gibbsian mixture. The reviewer finds this argument very difficult reading and has not satisfied himself that the steps all follow, though he feels sure that an argument can be carried through on these lines. He hopes that in some future edition this part of the book may be considerably expanded. He thinks that a discussion of the extension of Gibbs's own arguments, making use of maximum and minimum properties of canonical ensembles, to quantum theory, such as given by Delbrück and Molière, would find a place at this point; though perhaps that would be going further into statistical mechanics than the author intends. This statistical theory is then used to give a mathematically well-grounded first approximation treatment of absorption and stimulated emission of radiation.

The last two chapters contain discussions of electron spin and approximate relativistic theory and a rather detailed discussion of the problem of atomic structure, in which the assumptions and approximations made are carefully stated. The book concludes with appendices on particular mathematical points and name and subject indexes. It is well printed and this reviewer has discovered very few misprints. That, p. xviii, Condon and Shortley's "The Theory of Atomic Spectra" is attributed to "Oxford" instead of "Cambridge" may perhaps be noted.

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SPECIAL ARTICLES

ROD-CONE DARK ADAPTATION AND VITAMIN A

The association of vitamin A with the visual cycle has by now been firmly established not only indirectly by the occurrence of nightblindness with vitamin A lack,[1] but by the direct chemical identification in the retina of vitamin A and the carotenoid retinene.[2] Because of the presence of nightblindness and of the relation of retinene to visual purple, this association has generally been attributed to the retinal rods, since they mediate vision at low illuminations and contain visual purple.

However, the behavior of the rods and cones is so alike in many visual functions[3] that the association of vitamin A with cone vision also seemed quite probable. This has now been demonstrated by Haig, Hecht and Patek's recent study[4] of the dark adaptation of persons with cirrhosis of the liver. Such individuals are less sensitive to light than normal people, and the loss of sensibility occurs both in cone vision and in rod vision. With substantial additions of vitamin A to the diet, the subjects improve in visual function and become normal. The essential point is that the two retinal systems behave in a parallel manner during the various stages of vitamin A therapy, indicating that vitamin A is just as essential for the restoration of cone visual function as for rod visual function.

In cirrhosis, the flow of vitamin A from food to eye is disturbed by the failure of liver function. One starts with an abnormal visual condition, and by the addition of vitamin A eventually reaches a normal state, which can be maintained only by large dietary supplements of vitamin.

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[1] L. S. Fridericia and E. Holm, *Am. Jour. Physiol.*, 73: 63, 1925; K. Tansley, *Jour. Physiol.*, 71: 442, 1931.

[2] G. Wald, *Jour. Gen. Physiol.*, 18: 905, 1935, and 19: 351, 1935.

[3] S. Hecht, *Physiol. Rev.*, 17: 239, 1937; "La Base Chimique et Structurale de la Vision," Hermann and Co., Paris, 1938, 97 pp.

[4] C. Haig, S. Hecht and A. J. Patek, Science, 87: 534–536, 1938.

Because of this pathological factor, it seemed desirable to test the conclusions of Haig, Hecht and Patek by a study of normal individuals. We therefore measured the dark adaptation of four normal young men, first on their regular and adequate diet, and then on a diet containing only about 150 units of vitamin A per day in order to see whether under these circumstances rod and cone behavior also run parallel courses. Jeghers[5] has already made measurements of dark adaptation on one person subjected to vitamin A deficient diet, but due to inadequate apparatus and procedure his data do not separate rod and cone adaptation and thus fail to answer the present question.

Our measurements were made under carefully specified conditions so as clearly to separate rod and cone adaptation. We used the new adaptometer described by Hecht and Shlaer[6] and adopted their standard procedure involving preadaptation to 1,500 millilamberts for 3 minutes, and measurements with extreme violet light of the adaptation of a retinal area 3° in diameter situated 7° nasally from the fovea.

The results show unequivocally that cone function is affected by vitamin A changes, just as rod function is affected by them. Fig. 1 gives five curves of dark adaptation made with one subject during different stages of the deficient diet. In all the curves, the first section, occurring fairly rapidly, represents cone adaptation; after this reaches a level in a few minutes, the second section representing rod adaptation begins fairly abruptly after about 7 minutes in the dark. This cone-rod transition point remains the same during all the vicissitudes of the diet, and this is true for all four subjects. Such was not the case with the cirrhosis subjects, who showed an initial displacement of the transition point to as long as 15 minutes and its gradual migration toward the normal time during the course of therapy.

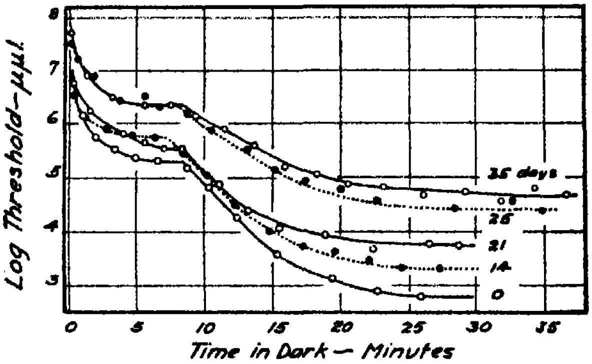

FIG. 1. Dark adaptation curves made at various times during a vitamin-A-free diet. Each point is a single observation.

Fig. 1 shows that as the stores of vitamin A in the body become exhausted, the general intensity level for both rods and cones rises. This is true not only for the final thresholds of cones and rods, but of the curves as a whole. The parallelism in behavior of the two functions is best shown in Fig. 2, where the data for two subjects are drawn. Those for J. M. are about average, while L. W. represents the extreme effect of the four subjects. Each point is the final threshold secured either from the cone or the rod sections of such curves as in Fig. 1. All subjects had been studied for several weeks before beginning the diet, and the thresholds from the last two runs made on the normal diet are shown above the diagonally shaded area in Fig. 2. The clear area represents the duration of the deficient

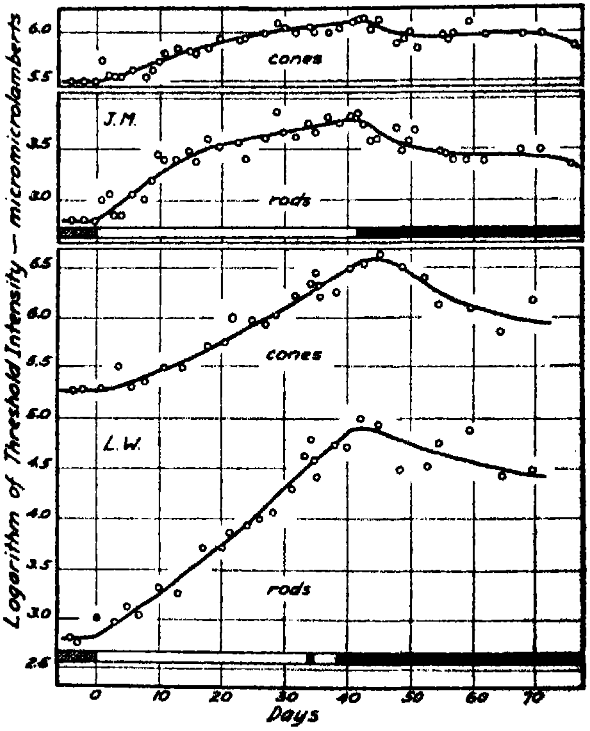

FIG. 2. The final rod and cone thresholds of two subjects on a vitamin A controlled diet. The diagonally shaded part represents a normal diet; the clear part is a practically vitamin-free diet; and the black part represents a normal diet plus 50,000 units of vitamin A daily. Note the points above the narrow black area for L. W. Both for rods and cones, this single administration of a large dose of vitamin A (100,000 units) seemed to cause a drop in threshold during the same day. In view of the prolonged time subsequently required for the threshold to come down to normal on a supplemented diet, we have not taken these points too seriously.

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[5] H. Jeghers, *Jour. Am. Med. Asn.*, 109: 756, 1938.

[6] S. Hecht and S. Shlaer, *Jour. Opt. Soc. Am.*, 28: 1938.

diet. *The similarity in behavior of cones and rods in dark adaptation is obvious.*

The black area means the return to a normal diet supplemented by 50,000 units of vitamin A per day. L. W. received 100,000 units in one day, but became ill for a few days following, during which he ate almost nothing and only resumed a supplemented normal diet later as indicated. The other two subjects merely returned to a normal diet without supplementary vitamin A. As Fig. 2 shows, there has been no spectacular return of visual function to normal on the resumption of regular and even excessive vitamin A consumption such as has been reported previously.[6, 7] There is a slightly rapid drop in threshold at first, but this gives way to a gradual decrease in threshold, and it may take longer to achieve complete recovery of function than it took to lose it.

For an understanding of the chemistry of vision, *the significant thing is the almost parallel behavior of* rod and cone thresholds during both the deficient and the recovery periods of the diet. This must mean that just as vitamin A enters into the chemical cycle of rod vision due to its association with visual purple, so it enters into the chemical cycle of cone vision, and that the cone sensitive substance[8]—iodopsin or visual violet—is very likely also a conjugated carotenoid protein like rhodopsin and porphyropsin.

This research was aided by a grant from the Rockefeller Foundation.

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NEW OBSERVATIONS ON THE VITAMIN K DEFICIENCY OF THE CHICK

IN view of the interest shown in vitamin K by biologists and clinicians, it is believed that recent observations made in this laboratory should become available to other investigators.

It was found that vitamin K will bring about a normal clotting time of the blood of the vitamin K-deficient chick within from 4 to 6 hours after oral administration by pipette and that the blood clotting time of the chick will become abnormally long again within a short time, *depending upon the amount of vitamin K* administered.

Chicks were reared on a vitamin K-low diet for 3 days, then on the vitamin K-deficient diet E of Almquist and Stokstad[1] for from 10 to 16 days. When the typical hemorrhagic diathesis had appeared, the chicks were fed 0.20 ml of cod liver oil containing 1 mg of vitamin K concentrate No. 13[2] prepared from alfalfa. At 2 hours' intervals after the administration of the concentrate, the blood-clotting time of the chicks was determined by the method of Almquist and Stokstad.[3]

The blood-clotting time was found to be more than 30 minutes after 2 hours; after 4 hours, the blood of about 50 per cent. of the chicks clotted within 10 minutes; and after 6 hours practically all the chicks were normal with respect to coagulation.[4]

The coagulation time of chicks which had received 1 mg of the vitamin K concentrate remained normal for more than 24 hours; at the end of the second day, the blood of about 50 per cent. of the chicks no longer clotted within 30 minutes; and at the end of the third day, all the chicks had an abnormally long coagulation time.

No change was observed in the blood-clotting time of chicks which had received 0.25 mg of vitamin K concentrate No. 13 dissolved in 0.20 ml of cod liver oil. Only a small percentage of the chicks responded to 0.5 mg. *The effect of 2 mg, likewise administered* in 0.20 ml of cod liver oil, was found to last for more than 48 hours; but at the end of the third day, all the chicks showed an abnormal clotting time. The administration of 3 mg of the concentrate in 0.20 ml of cod liver oil kept the coagulation power of the blood normal in about 50 per cent. of the chicks for 72 hours; it was found that 3.8 mg of the concentrate dissolved in 0.20 ml of cod liver oil was necessary to keep the blood-clotting time of all the chicks normal for 72 hours.

Obviously the above observations can be employed as the basis for a quantitative biological assay of vitamin K. Such a method has been used successfully with several hundred chicks and will be reported in full in the near future. This method would seem to fulfill the requirements of standardization studies for which there is an actual need, as pointed out recently in a paper by Smith *et al.*[5] on the effect of bile and vitamin K on bleeding tendency and prothrombin deficiency.

S. ANSBACHER
JUNE 29, 1938
SQUIBB INSTITUTE FOR
MEDICAL RESEARCH,
NEW BRUNSWICK, N. J.

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[7] C. Edmund and S. Clemmesen, "On Deficiency of A Vitamin and Visual Dysaptation," Copenhagen, 1936, 92 pp.; C. Fridericksen and C. Edmund, *Am. Jour. Diseases of Children*, 53: 89, 1938.

[8] G. Wald, *Nature*, 140: 545, 1937; A. M. Chase, SCIENCE, 87: 238, 1938.

[1] H. J. Almquist and E. L. R. Stokstad, *Jour. Nutrition*, 12: 329, 1936.

[2] Unpublished data from this laboratory.

[3] H. J. Almquist and E. L. R. Stokstad, *Jour. Nutrition*, 14: 235, 1937.

[4] Since this paper was written, it was found that the clotting power of the blood of the vitamin K-deficient chick may become normal within 2½ hours after the feeding of a relatively high amount of the vitamin K concentrate.

[5] H. P. Smith, E. D. Warner, K. M. Brinkhous and W. H. Seegers, *Jour. Exp. Med.*, 67: 911, 1938.

MATHEMATICAL EXPRESSION OF EQUILIBRIUM BETWEEN LIME, MAGNESIA AND POTASH IN PLANTS[1]

THE existence of a relationship between calcium, magnesium and potassium with respect to their absorption by plants has been suggested by many investigators. Loew[2] maintained that plants require a definite CaO/MgO ratio in their medium; Ehrenberg[3] enunciated his so-called "potash-lime law"; and Wiegner and Müller[4] deduced a relationship between calcium and potassium in the soil solution from conditions governing their equilibrium in the exchange complex.

The final truth, however, regarding the nature of the adaptability of the nutritive medium (soil) to the needs of the plant must lie in the mathematical description of the physiological processes within the plant itself. From this point of view, mathematical expression for the physiological relationships between certain elements ("entities") and plant response have been sought, expressible in terms of simple laws.[5,6]

In continuance of our investigations on foliar diagnosis[7] Plot 22, Tier 1, of the Jordan fertility field experiments has received since 1881 manure at the rate of 6 tons per acre applied to corn and wheat in a four-year rotation and has been limed at the rate of 2 tons per acre every four years. This treatment has given the highest yields on this Tier 1. In 1936 the yield of corn was 770.8 pounds per one eighth-acre plot. The plants on this manure plot, therefore, may be considered well nourished and near optimum for the soil and climatic conditions of this region.

In Fig. 1 is plotted in trilinear coordinates a magnitude designated the *CaMgK-unit,* representing the equilibrium between CaO, MgO and K_2O at the moment of sampling. It is derived by converting the percentage composition for CaO, MgO and K_2O of the third leaf into milligram equivalent (m.e.) values, and determining the proportion each of these bears to the milligram equivalent total. To avoid fractions, these values are multiplied by 100. The treatments indicated are of plants growing on the manure plot (Plot No. 22), together with six plots treated as follows: namely, nothing (Plot No. 1); nitrogen (Plot No. 2); superphosphate (Plot No. 3); potash (Plot No. 4); nitrogen + phosphate + potash (Plot No. 9); and lime (Plot No. 23). The numerals 0, 1, 2, 3, 4, indicate the coordinate points for the dates of sampling, June 16, July 6, July 21, August 8 and August 25, respectively, in 1936. The straight (broken) line marked *ln* in Fig. 1 has been formed by joining the coordinates (see columns 1 and 2, Table I) for the values obtained at the second and fourth samplings, taken on July 6 and August 8, respectively, of leaves of the same metabolic [illegible] from plants growing on the optimum (manure) plot. *The equation of this line is* $y = 0.305\,x + 0.505$. The values from June 16 to August 8 lie sensibly on this line, deviation from which commences only at the last sampling date, August 25, with the incipience of chlorophyll degeneration.

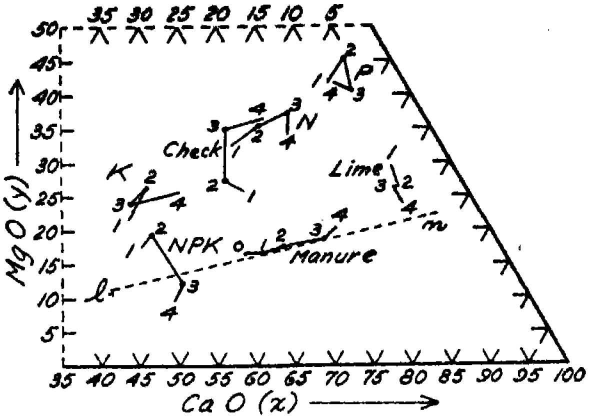

FIG. 1. Showing the deviations from the optimum physiological balance between lime, magnesia and potash in seven differently treated plots.

Since, by our procedure[8] the sum of the values of any coordinate point (x + y + z) is equal to 100, and inasmuch as y = mx + b, it follows that any two of these variables are related by a linear equation. The deviation of experimental values calculated from the above equation is shown in the last column of Table I.

TABLE I

EXPERIMENTAL VALUES AND VALUES CALCULATED FROM THE EQUATION REPRESENTING THE EQUILIBRIUM BETWEEN CAO – MGO, AT FIVE SUCCESSIVE DATES OF SAMPLING FOR PLANTS GROWING ON THE MANURE PLOT

Dates of sampling	Experimental values		Calculated values	Relative deviation
	MgO (y)	CaO (x)	CaO (x_1)	$\frac{x - x_1}{x}$
June 16 ..	15.600	50.245	49.492	+ 0.015
July 6 ..	16.561	52.032	52.632	0
July 21 ..	17.238	54.463	54.865	– 0.008
Aug. 8 ..	18.634	59.427	59.427	0
Aug. 25 ..	20.105	60.395	64.262	– .063

The yield of grain from the five unlimed plots are: nothing (Plot No. 1), 165.4 pounds; nitrogen (Plot No. 2), 265.5 pounds; phosphate (Plot No. 3), 371.2 pounds; potash (Plot No. 4), 298.3 pounds; nitrogen + phosphate + potash (Plot No. 9), 520.2 pounds;

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[1] Authorized for publication as Paper No. 838 in the Journal Series of the Pennsylvania Agricultural Experiment Station.

[2] Oscar Loew, *Flora,* 75: 368–394, 1892.

[3] Paul Ehrenberg, *Landw. Jahrb.,* 54: 1–159, 1919.

[4] G. Wiegner and K. W. Müller, *Ztschr. Pflanzenernähr. Düngung u. Bodenk.,* (A) 14: 321–347, 1929.

[5] H. Lagatu and L. Maume, *Compt. Rend.,* 179: 782, 1924.

[6] Walter Thomas, SCIENCE, 84: 422–423, 1936.

[7] Walter Thomas, *Plant Physiol.,* 12: 571–600, 1937.

[8] *Ibid.*

and from the limed plot (Plot No. 23), 452.2 pounds.

The deviation from the optimum (broken) line with respect to position, form and length between sampling dates shows in each case the nature of the disequilibrium between CaO-MgO-K_2O resulting from the different treatments.

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SCIENTIFIC APPARATUS AND LABORATORY METHODS

AN INEXPENSIVE SURFACE TENSIOMETER[1]

Lloyd and Scarth (Science, 64: 253, 1926) devised a simple and cheaply made tensiometer which combined the ring method of measuring surface tension with the essential mechanism of a chainomatic balance.

In our own laboratory we have made a few improvements on their device for measuring surface tension, improvements worth offering to instructors with classes too large for duplication of the excellent but comparatively expensive Du Nouy tensiometer. It is even possible that many research workers may find this apparatus in its improved form adequate for their needs.

The total cost of materials is less than one dollar if a nickel wire ring is made, and not more than three dollars if a standard platinum ring is purchased. Any chemist can build this tensiometer in a few hours.

The accuracy possible is rather astonishing. Readings within 0.1 dyne of the true values for pure liquids have been made by our own students.

The diagram will indicate the general features. Instead of using a single thin strip of bamboo for the balance lever (as advised by Lloyd and Scarth), we now obtain greater stiffness, and a desirable length with light weight, by connecting two bamboo strips, approximately 35 cm long, with two strips 5 cm long placed near the mid-point. The long strips of bamboo are bent sufficiently to permit tying together with strong thread or thin wire at the ends.

Between the two short bracing strips is placed a thin sheet of aluminum, approximately 0.7 × 3 cm, to serve as a fulcrum rest. The aluminum strip is twisted at the ends to grasp the short bracing strips of bamboo and is smoothly creased in the middle to give a resting place on the razor edge. We have considerably increased the delicacy of beam movement by using a safety razor blade as fulcrum. Of course this blade is firmly attached to the substantial wooden support (at the left). A strip of metal, bent at a right angle and perforated for two screws, makes a good support. Two very light wire hooks are attached to the ends of the beam or balance arm—one as support for the wire ring and the other as point of attachment for one end of the chain.

The ring may be purchased or shaped from platinum or nickel wire (24–28 gauge) by bending around a glass tube of approximately 1.3 cm diameter. Of course, a length of this wire extends almost vertically about 3 cm as a "handle" or arm of the ring. A small loop shaped at the end permits the ring to swing freely from the end of the beam. Platinum rings are best, yet nickel rings are almost as good. It is not difficult to weld two platinum supporting wires to meet above the ring.

In our laboratory we have found the light aluminum chain attached to ten-cent jewelry (Woolworth's and others) to be very suitable for this tensiometer. This chain is extended in length with a piece of strong thread which passes through a small metal ring (or screw-eye) near the top of the vertical board. Near the bottom of the board this thread is wound around a wooden cylinder (half of a common spool or a wooden drawer knob) so attached to the board that it turns stiffly when desired. The smaller the links in the chain the more accurate the readings.

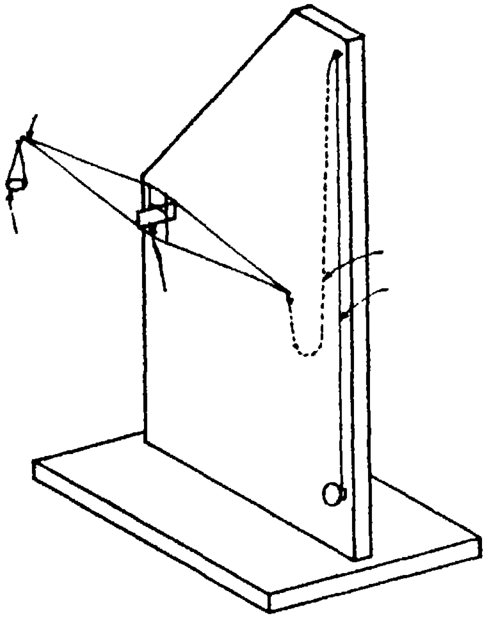

Fig. 1

After trying various lengths of beam to secure the best combination of lightness, stiffness and accuracy, we decided that a length of about 35 cm was most desirable.

The wooden support for the moving parts consists of two common boards nailed together at right angles, as shown in the diagram. A maximum height of 55 cm allows sufficient movement of the chain, and a width of about 27 cm is suitable for the vertical board. A coat of shellac prevents warping.

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[1] Several students have offered useful suggestions, notably Malcolm Keiser and Croom Beatty.

The dish containing the liquid for surface tension measurement is most simply held in the hand, but is best supported at the proper level for greater accuracy with an adjustable platform.

A graduated scale (sheet of graph paper) on the supporting board makes it possible to record accurately the changing positions of the end snap or any other marked link in the aluminum chain. To make a reading the beam is leveled so that the end at the right (with projecting wire pointer) points directly to a "rest mark" or heavy line appropriately drawn on the sheet of graph paper pasted on the board. The clean vessel of liquid is raised until contact is made with the ring and the chain adjusted so that there is no pulling away from the liquid. If ethanol or other liquid of low surface tension is to be used, the chain must be pulled up rather high before releasing the beam. The chain is lowered cautiously until the increasing weight of the sagging loop just tears the ring from contact with the surface of the liquid. This procedure is repeated cautiously until the scale reading corresponding to the breaking point can be determined accurately. At the breaking point the position on the arbitrary vertical scale of the snap or other marked link of the chain is observed. This position on the scale is set down as the scale reading corresponding to the surface tensions of that particular liquid, at room-temperature.

To prevent violent movement of the beam as the ring pulls away from the liquid, we placed a small right angle hook on the vertical board so that the beam in level position moves only a little above or below it. This was possible because of the two-splint construction of the beam. The ring must be cleaned before use (and on changing liquids) by dipping in alcohol, in water, and finally by brief heating in a blue flame. Fingers must not touch the ring.

To calibrate the apparatus, such scale readings are determined for a few pure liquids of known surface tension.

To illustrate the application to an unknown, we offer the "key" diagram for one particular tensiometer built by a student. A sheet of graph paper pasted on the vertical board serves as scale and permits plotting of a reference curve. On the horizontal axis is a scale of surface tension values in dynes, while on the vertical axis is an arbitrary scale of such units as are read with this particular tensiometer. For seven pure liquids, points on coordinate or graph paper were plotted in accordance with scale readings, and true surface tension values (corrected to the temperature of operation) obtained from reference books. In actual practice with this particular tensiometer, these seven points were connected with a single straight line—excellent confirmation of accuracy.

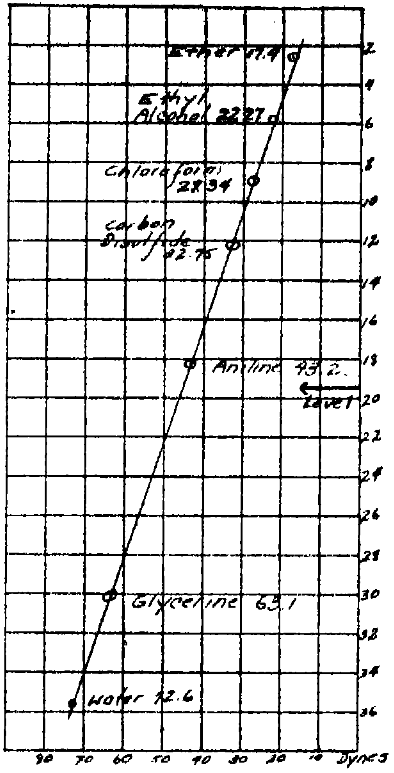

Fig. 2

After determining the scale reading for an unknown, as 22.5, for example, a glance at the diagram indicates a corresponding surface tension value of 50 dynes.

(Excellent detailed instructions for use of the Du Nouy tensiometer are found in Bulletin 101, printed by the Central Scientific Company of Chicago. An elaborate chainomatic tensiometer is sold by the Arthur H. Thomas Company of Philadelphia.)

Harry N. Holmes

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BOOKS RECEIVED

- Brown, Harry B. *Cotton; History, Species, Varieties, Morphology, Breeding, Culture, Diseases, Marketing, and Uses.* Second edition. Pp. xiii + 592. 140 figures. McGraw-Hill. $5.00.
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SCIENTIFIC APPROACHES TO THE STUDY OF THE HUMAN MIND[1]

By ARNOLD GESELL, M.D.

DIRECTOR OF THE CLINIC OF CHILD DEVELOPMENT, YALE UNIVERSITY SCHOOL OF MEDICINE

WE are met to inaugurate a museum of psychology. May I begin by quoting a letter which I recently received from a spirited adolescent girl, age 14? "I have many hobbies," she wrote, "in fact they are almost countless. The one I like best is keeping a museum. As you probably remember, our house is quite large. My museum (the name of it is 'A Country Museum') is one of the smaller rooms upstairs. . . . Some of the things are Indian arrow heads, a tip of an Indian ax, a hornet's nest, and some butterflies. The thing that I thought would be interesting is to try to get a stone or two from every state of the union. . . ." So I sent her a rock from Connecticut.

There is a good deal of psychology in that letter; not so much in the rock itself. A psychological museum must deal with phenomena less substantial and less accessible than rocks and hornet nests. Can it succeed in giving tangibleness to the human mind? The Lewis Institute, your trustees and director have undertaken a project of great difficulty, but one which has important pioneering possibilities. Museums have in general been devoted to the products and often to the curiosities of human culture. A psychological museum will have to concern itself in a new way with a delineation of the nature, mechanisms and the needs of human behavior. It will have to design a new kind of transparent man. Its problem is to objectify, to make visible, the operations and the laws of the human mind, to give us an inside look. In this age of photography, of pictorial journalism and of the motion picture, of window displays and of murals, the race wishes to see with its own eyes, to look. More eagerly than ever, we are trying to get glimpses of ourselves.

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[1] Address delivered at inauguration ceremony of Psychological Museum and First Psychological Exposition, Garfield Park, Chicago, May 4, 1938.

Ancient man was moved by similar impulses. When he scratched and daubed his own murals of a bison hunt on the walls of a cave, he got a little further outside of himself and a better perspective upon himself. This was his art gallery and museum. But his psychology was crude. He had only the dimmest notion of his mental life and the mental life of others. He was confused by the echo in the valley, by the reflection of his own image on the water surface, by vapor and wind. He could not have understood William James's chapter on "The Stream of Consciousness," even if it had been translated into Neanderthal. (But even William James is rather recent, for it was only seventy years ago that he returned to America from Germany with tidings of a possible science of the mind.)

Savage man is to this day literally afraid of his own shadow. He regards his shadow as his very soul, or as a vital part of himself. The natives of Nias, Frazer tells us, tremble at the sight of a rainbow, because they think it is a net spread by a powerful spirit to catch their shadows.

Modern science has done something for us. It has at least explained the optics and the physics of the rainbow. And at long last, science is also removing some of the lingering terrors and mysteries of the human soul.

Psychology used to be defined as the science of the human soul. It makes little difference if we substitute the words human mind or human behavior. It is an error, however, to think of psychology as *the* science of the mind—as the one and only science of the mind. The organization of modern sciences is such that no one science can be allocated to a distinct and detached province. This is particularly true of the life sciences and their subdivisions. Only the dictionary maker can draw sharp cleavages to-day between physics, chemistry, biology, physiology and psychology. The whole trend of contemporary science is toward hyphenation and interpenetration. Johns Hopkins recently created a chair of physiological anatomy. Some time ago such a hybrid would have been regarded as grotesque. To-day we grant that static phenomena can be studied in the making. We also recognize that the most creative advances of science take place at the growing margins where diverse fields of science touch each other and lose their separate identities. The tendency toward excessive specialization is counterbalanced by a tendency toward hyphenation which brings disciplines into union. Witness psycho-biology, neuro-psychiatry, bio-physics, psycho-somatics, etc.

Paradoxically, the highest reaches in specialization require the profoundest fathoming into fundamentals. W. B. Hardy, for example, we are informed, started his career as a biologist but ended as a physicist, studying the phenomena of lubrication and the molecular structure of silk and wool fibers. Did he go astray? Not if we grant that the characteristics of protoplasm remain a mystery without a thorough knowledge of viscosity. We can not even be certain that he has not made an ultimate contribution to psychology, via the study of lubrication! Such round-about implication and deviousness of approach are in fact characteristic of the structure or rather the physiological anatomy of modern science.

Diverse sciences show a tendency to interpenetrate. This is peculiarly true of the study of the human mind. The psyche, the behavior of a man, is a focal manifestation of the "forces" of nature. Man is part of the order of nature, the same order which determines the differential elasticity of silk and wool fibers and the stripes of the rainbow. His psychology is an integrated expression of all the factors that contribute to the ordering of life. Neither the integration nor the factors can be comprehended by traveling the narrow trail of a single scientific discipline.

There are, accordingly, many scientific approaches to the problems of human psychology. I use the term approaches deliberately to suggest the broader avenues which lead to the central city of Man-Soul. The term is not necessarily synonymous with method. An approach is a pathway; a method is a manner of procedure by which you travel. Statistical method, for example, represents a tool, a mathematical device for the clarification and formulation of data rather than the creation of data. The experimental method, when it deals with crucial and predictive issues, is in many respects supreme. We are inclined to agree with Boring's contention that "the application of the experimental method to the problem of mind is the great outstanding event in the history of the study of the mind, an event to which no other is comparable."

It does not follow, however, that the science of the human mind has depended, or will depend, entirely upon direct experimentation with specific psychological phenomena. More than any other science, psychology will be derived from basic, contributive disciplines which deal with the subordinate but determining orders of nature. The science of psychology will continue to grow by a social process of accrual. It will advance on tidal currents generated by the basic sciences. Already it has burst the confines of a somewhat conventionalized series of text-books. At the moment we do not so much need a genius who will make original experimental discoveries in the realm of mind. Rather we need a Darwin who will reveal, coordinate and consolidate the unlabeled psychological knowledge which has already accrued, but has not yet become intellectually integrated.

There are at least five fundamental approaches to the comprehensive science of the mind, and none of these is purely psychological. From a monistic standpoint of determinism, we need not insist too rigidly upon distinctions between mind and matter or between structure and function. We are obliged to reckon with all forms of relatedness which truly reflect the universal order and the regulatory principles that pervade alike animate and inanimate nature. Without aiming at symmetrical emphasis, our comments will deal with (1) Neurophysiology, (2) Chemistry, (3) Clinical Studies, (4) Developmental Morphology, (5) Cultural Anthropology. More direct and introspective approaches we shall not attempt to consider.

(1) *Neurophysiology.* Scientific psychology arose within the domain of physiology. Must it not always have a deep root in the physiology of the nervous system? For the nervous system supports and serves the fundamental functions of sensation and movement, which constitute the very essence of mind. To be sure you can not adequately "represent thoughts and emotions as nerve cells tickling one another." E. W. Scripture in a moment of autobiographic candor went on to say, "I throw aside every book on psychology the moment I see a picture of the brain in it." We can not, however, find support for this bit of Scripture in the writings of Sir Charles Bell, Johannes Müller, Magnus, Pavlov, Sherrington or Lashley.

Sechenov in 1863, in a famous lecture on "The Reflexes of the Brain," initiated a new chapter in science. "All psychical acts without exception," he boldly asserted, "if they are not complicated by elements of emotion, are developed by means of reflexes." From this thesis have sprung some 2,000 published studies of the conditioned reflex, with titles ranging from "The Withdrawal of the Tubeworm from a Shadow" to "The Investigatory Reflex of Homo Sapiens."

Neurophysiology is to-day one of the most active fields of hyphenated science. The techniques are becoming increasingly refined. A century and a quarter ago it was an epoch-making discovery to make a simple distinction between the sensory and motor roots of the spinal cord. To-day the almost infinitesimal currents of nerves and nerve centers are registered, their rhythms photographed in curves of beautiful precision. With devices for both auditory and visual magnification, the electrometry of the brain has swiftly amassed voluminous data—more in fact than the investigatory cerebrum can immediately cope with. By the method of thermo-coagulation, individual layers of the brain cortex are being separately explored. By means of ultra delicate probing, microscopic groups of nerve cells are being identified in the medulla. Such researches are destined to give us an intimate knowledge of the architecture of the nervous system, and this knowledge will make our concepts of human behavior more deterministic and mechanistic in the best scientific sense.

It can scarcely be argued that these neurophysiological studies lie too deep below the threshold of consciousness and outside the scope of psychology. Even in the detailed studies of animal respiration, it has been found that no two dogs breathe exactly alike. Individual differences in dogs and man must be studied on a neurophysiological level.

The work and the career of George E. Coghill furnish solid evidence of the scientific significance of the neurophysiological approach. His primary interest was psychological, but even as a graduate student he says, "I became aware that the natural approach to the kind of psychological information I wanted lay through the physiology of the nervous system. Obviously, also, the physiology of the nervous system must be approached through its anatomy, about which I knew nothing." So for thirty years or more he has been making minute studies of the genetic and functional histology of *amblystoma*, a mere mud puppy. Did he go astray?

Although Coghill has not made a single experiment in psychology, in the orthodox sense, he has already had a profound influence on the biological interpretation of psychological problems. His three lectures on "Anatomy and the Problem of Behavior," delivered in London, bid fair to become classic. The thin volume which contains them belongs on a five foot shelf.

(2) *Chemistry.* Chemistry is one domain of science which is certain to make epochal progress during the next few decades. And this progress, we may well believe, will reshape our concepts and control of human behavior. The Associated Press, in its report of the recent meeting of the American Chemical Society, characterized the newly purified protein prolactin as "this mother-instinct-crystal." Here we have hyphenation with a vengeance, but with more than journalistic justification, for it is literally true that this chemical substance releases, sustains and intensifies fundamental emotional reaction in different species equipped with mammary glands. (The newspaper headlines were startling enough: "Yale hormone makes tom cats give milk and roosters brood!")

Osler, in a more than humorous aside, while lecturing on endocrinology, told his audience that their ability to listen to his lecture depended upon the functioning at that very moment of their thyroid glands. These glands secrete thyroxine, a substance which is inextricably bound up with the phenomena of attention and memory, growth and learning. A universal history of psychology would have to give a place of honor to Kendall, who isolated thyroxine in 1918.

To illustrate the psychological implications, I may cite an illustration. For a period of twelve years we have followed the mental development of a girl who was diagnosed as a cretin in early infancy. She was fed thyroxine at the age of six months. She has attained a normal level of intelligence, thanks to the thyroxine which she has taken regularly all these years, with one exception. At the age of nine years temporary myxedema developed, due to a pharmaceutical error. The druggist having made a mistake, she was fed for one month on thymus rather than thyroid substance. Cretinous signs at once emerged, but retreated as soon as thyroxine was substituted. This child's psychology literally hangs on a thyroid thread, and in observing her we have acquired a healthy respect for the chemical basis of mental life.

The pharmacopoeia lists an amazing number of drugs which have psychological effects. Some day no doubt the mechanism of these effects will be better understood in terms of molecules, atoms, chemical mosaics and chemical configurations. Neurophysiological processes will be conceived chemically. Already they are being envisaged in terms of electrochemistry and the distribution of electric potentials.

The ordering factors of life are at bottom chemical, whether they be subatomic, atomic, molecular, colloidal, paracrystalline or anatomical. These chemical factors probably even determine the Gestalten of psychology. There is, in the words of Needham, "a hierarchical continuity." Biochemistry is increasingly concerned with the morphology as well as the constituency of matter, and is bridging the gulf between sciences of matter and of form. ". . . the fields of morphology and biochemistry are not so sundered as is often supposed. Organizing relations are found at the molecular level and at the colloidal and paracrystalline level, as well as at the anatomical level. Hardy's work, far from showing that no structure existed in the cell, showed on the contrary how subtle it must be. Although we are still in the earliest historical stages of any far reaching organization-calculus, we can yet see that biological order, like (but very much more complicated than) crystal order, is a natural consequence of the properties of matter, and one characteristic mode of their manifestation."

Needham should be able to speak with authority, for he has compiled three scholarly volumes entitled "Chemical Embryology." Is it not probable that some day we may have an equally monumental work on Chemical Psychology?

(3) *Clinical Studies.* Under this heading we wish to stress the importance of clinical materials and naturalistic data rather than the peculiar merits of clinical procedure. There is no occasion to make an invidious distinction between clinical and experimental methods. Each may reinforce the other. Healthy progress in experimental medicine depends upon corrective contacts with the realities of clinical medicine. The same interdependence holds for clinical and experimental forms of psychology.

There is a whole host of "experiments" which no scientist has the ingenuity to plan nor the gift to perform: Nature performs them and presents them to him as riddles to solve. They take the shape of monsters, of freaks, of abnormal, eccentric, atypical individuals. The anomalies and the deviations may involve the total organism, they may involve only a sector or a small phase. In such moments of abnormality, as Goethe once remarked, nature reveals her secrets. That is, she reveals them if we meet the challenge and make sufficient effort to explain her experimental vagary.

The feebleminded, the insane, the psychopathic, the genius, will always provide rich materials which can be encompassed only by expert familiarity, by a naturalistic feeling for reality and by intuitive insight. Let us not underrate the vast opportunities for productive interpretation. "It would seem," as Wilfred Trotter says in an acute article in the *British Medical Journal,* "that it must be an advantage to an experimental science to have an observational side, the function of which, in addition to its use as an implement of research, would chiefly be to promote the atmosphere of intellectual liveliness which is so important as evidence of health."

The unusual elucidates the usual, the abnormal helps to define the normal, because one is a variant or exaggeration of the other. There is one type of clinical material which furnishes extraordinary opportunity for controlled, comparative observation because it comes in pairs; namely, twins. Twins are interesting in their own right, but scientifically they are most significant when used as touchstones for the elucidation of biological and psychological phenomena.

The *method of co-twin control* is an experimental device for analyzing biogenetic problems, with special reference to mental growth, learning and individuality. Twins, particularly young monozygotic twins, are almost made to order for such biogenetic studies. In identical twins, nature provides a stage for comparatively observing the effects of a developmental stimulus which may be deliberately confined to one twin. By comprehensive cross reference, the co-twin becomes a control and a check both upon observation and conclusions. This method reaches its greatest efficiency when a high degree of correspondence has been established by careful measurements prior to the experimental observations. Careless use of the method and failure to define thorough-going comparisons in advance should be deprecated.

The method has a certain statistical validity, even when confined to a single pair of twins. The "statistical" validity resides in the numerousness of the physical, biochemical and developmental correspondences which are so extensively present in monozygotic twins. The correspondences are sometimes so refined as to be little short of uncanny, as witness the exquisite similarities of twin electro-encephalograms. Where else in nature or in the samplings of the laboratory can we match in scope and detail the biological equivalence of identical twins?

From a research standpoint we need not unduly deplore the fact that quintuplets occur only once in 19,698,322 pregnancies. Twins we shall always have with us in ample numbers of highly similar pairs for clinical and experimental studies.

(4) *Developmental Morphology.* In the study of the human mind one can not escape problems of pattern and form. When Goethe coined the word *Morphologie*, he was interested in the forms of flowers and skulls. To this day the term carries physical connotations. But the concepts of morphology can be extended to the phenomena of behavior. Morphology is the science of form. Let the dictionary remind us that form is the shape of anything as distinguished from the substance of that thing. Behavior has shape.

The shapes which behaviors assume can be investigated in their own scientific right. A morphological approach leads to the description and measurement of specific forms; the systematic study of topographic relations and correlations of such forms, their ontogenetic progression and involution; their comparative features among individuals and among species.

"Structure is only the intimate expression of function," was a leading maxim of John Hunter. In a monistic (but not mystic) sense "the mind" may be regarded as a living, growing "structure," even though it lacks corporeal tangibility. It is a complex, organizing action system which manifests itself in characteristic forms of behavior—in patterns of posture, locomotion, prehension, manipulation, of perception, communication and social response. The action systems of embryo, fetus, infant and child undergo pattern changes which are so sequential that we may be certain that the patterning process is governed by mechanisms of form regulation—the same mechanisms which are being established by the science of embryology.

Experimental embryology is now one of the most active and flourishing of all the life sciences. It has undertaken the analysis of development, particularly as it affects the anatomy of the organism. But the investigators are increasingly using functional and behavior criteria to define the somatic anatomy. This is natural, for by the principle of hierarchical continuity, there is but one physiology of development. The growth of tissues, of organs and of behavior is obedient to identical laws of developmental morphology.

It can not, therefore, be doubted that the general physiology of mental development will find its deeper roots in the same scientific soil which is now intensively cultivated in laboratories of experimental embryology. Already many of the current morphogenetic concepts have more than vague analogy to psychical processes: embryonic field, gradient theory, regional determination, autonomous induction, complementary induction, potency, polarity, symmetry, time correlation, etc. Associationism as a psychological tradition has come down from Aristotle and still has considerable vitality, as shown by a prodigious preoccupation with problems of learning and the conditioned reflex. The laws of association deal with the factors of contiguity, assimilation, frequency, primacy, intensity, duration, context, acquaintance, maturity. Needless to say, these laws will some day be reformulated in terms of the biology and physiology of development. The full coordination of animal and human psychology will depend upon such reformulations.

A more concrete paragraph may be in order here. Take for illustration the tonic neck reflex (t.n.r.), an interesting, asymmetric pattern of behavior common to man and lower animals. Magnus discovered that when he rotated the head of an experimental rabbit, a characteristic response occurred: (a) extension of the forelimb on the side toward which the head was turned, (b) flexion of the opposite forelimb. We have found this postural attitude a ubiquitous characteristic of the human infant in the first three months of life. It is his preferred posture, as he lies supine, awake, head averted. By the age of 20 weeks, his head prefers the midline, his arms assume symmetric positions and frequently meet above his chest. The human t.n.r. is not a stereotyped reflex, but a growing pattern changing with the maturity and the economy of the organism. It involves far-reaching elaborations in eye-hand coordination, prehension, prone locomotion, laterality. It displays significant individual differences in motor demeanor and psycho-motor constitution.

This behavior form, which has essential counterparts in quadrupeds, exemplifies both the bonds and the cleavages between human and animal psychology. It may also suggest the validity of a broad morphological approach to the study of the human mind. In spite of an enormous descriptive literature, one might legitimately hold that human psychology is deficient in fundamental description, because it has not reckoned systematically with the form characteristics of behavior. We lack the grammar and the lexicon for formulating these form characteristics. We must develop morphographic methods which will simplify and generalize form phenomena. A psycho-morphological approach will also bring us closer to the ancient problem of psychic constitution and of mental types. It is indispensable for the delineation of the ontogenesis of human behavior and the comparative psychology of life cycles.

(5) *Cultural Anthropology.* Hamlet must not be left out of the play. In fact, in the Story of the Human Mind, there are two Hamlets: the Biological Adam and Culture! Culture, as Malinowski aptly put it, is nothing but the organized behavior of man. The scientific study of the patterning of human culture would seem to constitute a fundamental approach to the science of the individual mind, which mind is in part a product, in part a creator, of the culture in which it has its being. Culture is "a large-scale molding matrix, a gigantic conditioning apparatus. In each generation it produces its type of individual. In each generation it is in turn reshaped by its carriers."

We are quoting Malinowski, for he is no mean authority and he grew up in the tradition of the exact sciences, including laboratory training in physical chemistry and experimental psychology at the University of Leipzig. As the founder of the functional school of anthropology, he holds that there exist scientific laws of culture. "Culture is a determinant of human behavior, and culture as a dynamic reality is also subject to determinism."

The term culture comprises much. It includes the prosaics of food getting and of everyday family life, as well as the exoticisms of ceremony and magic. It is not assumed that multifarious masses of anthropological data must be incorporated into the subject-matter of psychology. However, the anthropologist sees in living cultures, in spite of their apparent diversity, a pervading sameness, arising out of common traits of human nature. This quality of sameness denotes underlying psychological laws which should enable us to better understand ourselves and our cultures, including religion, morals, mores and government. Thus also we may arrive at more insight into the diseases of culture as manifested in poverty, economic crises, crime and war. It is not strange that cultural anthropology claims to be the very basis of social science. But scientific anthropology, no less than psychology, is inextricably bound up with physics, chemistry, physiology and biology. Culture began with a very primitive man who has not lost all his primitiveness.

The understanding of the human mind, it therefore seems, will be attained not through the researches of a single discipline, but through the conjunctive results of a great interlocking system of sciences, a system which is itself the most characteristic cultural product of our technological civilization. No previous culture has ever achieved a product more magnificent than the present body of natural and engineering science. This achievement is our hope, as well as our despair. The despair will not lessen until the techniques of modern science can be more sincerely brought to bear on problems of behavior. Only through profound self-knowledge can the human mind bring itself nearer to individual and collective control.

THE AMERICAN MATHEMATICAL SOCIETY 1888–1938

By Professor **ALBERT E. MEDER, JR.**
NEW JERSEY COLLEGE FOR WOMEN

IT is indeed strange that organized mathematics in America is only fifty years old, especially in view of the fact that mathematics is as old as civilization itself and that in Europe the seventeenth and eighteenth centuries were periods of tremendous mathematical advance. On this continent, however, even a half century ago there was but little mathematical research. To be sure, contributions to the science had been made by Robert Adrain, Nathaniel Bowditch and Benjamin Peirce of an earlier generation and by G. W. Hill, Simon Newcomb and Josiah Willard Gibbs among contemporaries, the *American Journal of Mathematics* was in its tenth year, a few universities had been sending out doctors in mathematics for some little time, and a number of Americans had received degrees from European universities, yet this activity was scattered and somewhat sporadic, and there was little cooperation or feeling of solidarity among American mathematicians. The time was ripe, however, for the formation of an organization to draw together those Americans interested in mathematical pursuits, and to foster actively the development of mathematical scholarship and research in this country.

It was not, however, the well-known mathematicians who took the initiative in forming such an organization. A young college instructor in his first year of service, Dr. Thomas Scott Fiske, of Columbia College, but recently returned from a period of study in Cambridge, at which time he had attended meetings of the London Mathematical Society, thought, as he put it, that there should be "a stronger feeling of comradeship among those interested in mathematics," and proposed to two of his friends the formation of a similar society in New York. So it happened that three young men of twenty-three signed the call for the organization meeting, to which six persons responded and completed the organization of the New York Mathematical Society. J. H. Van Amringe, professor of mathematics at Columbia, was chosen president, and Fiske secretary, an office he held for seven years.[1]

The 6 increased to 16 by the end of 1889, to 23 in 1890, then, following a campaign for members directed by the secretary, to 210 at the end of 1891. In 1920 it was 770, and at the end of 1937, 2,127.

In 1891 the monthly publication, *Bulletin of the New York Mathematical Society*, was begun as "a historical and critical review of mathematical science" under the editorship of Professor Fiske, who established high standards in the development of what was essentially a new type of mathematical journal.

Three years later the society began the custom of holding summer meetings, and with the inauguration of this series changed its name to American Mathematical Society as a more accurate description of its constituency. Valuable as these summer meetings proved to be, with their larger attendance, wider geographic distribution and longer duration than the regular winter meetings, there was a further need which the society could satisfy. The suggestion came from Professor H. S. White in these words: "a series of three to six lectures . . . on selected chapters . . . bringing some fundamentals, but progressing also to some few of the highest and latest results of research." The society council was favorable; the name Colloquium was adopted for this activity, and in 1896 the colloquia were initiated in connection with the summer meeting of that year, the lecturers being Maxime Bôcher, of Harvard, and James Pierpont, of Yale. There were thirteen in attendance. Since that time there have been nineteen additional colloquia, and the attendance has reached a high point of 220. It is now the policy of the society to publish the Colloquium lectures, as well as to include in the series of Colloquium publications other monographs expository of new mathematical developments, even though these have not been orally presented. Twenty-four volumes in this series have been issued, and it is no exaggeration to say that they are internationally recognized as authoritative and distinguished presentations.

By this time the society's membership was so large (275) and so scattered that the meetings in New York and the summer meeting were inadequate properly to serve the membership. In 1897 there was therefore organized the Chicago Section, which continued an extremely active and productive existence until 1924, when its meetings became regular meetings of the society. The sectional organization was later extended to the western group, constituting the San Francisco Section, 1902–1929, and the Southwestern Section, 1906–1928. All meetings of the society in any section of the country are now regular meetings of the organization as a whole.

By 1898 the society began to feel the need of a journal for the publication of original mathematical research. Negotiations were begun with the Johns Hopkins University looking toward a cooperative arrangement with the *American Journal of Mathematics* whereby it would be enlarged and published jointly by the university and the society, the latter bearing the additional expense. The editorial control was to be vested in the society. These negotiations were not successful, and the society proceeded to consider the advisability of establishing its own journal. Once again Professor Fiske was the leader in making the arrangements. The younger men were all agreed as to the desirability of the step, but some of the older men feared that the establishment of such a journal would constitute a rival or competitor of the *American Journal of Mathematics*, and this would be both unfriendly toward the older publication and unfortunate in itself. The title *Transactions of the American Mathematical Society* was chosen to overcome these objections, for all were agreed that any society might publish its transactions without unfriendly inference. Professors E. H. Moore, E. W. Brown and T. S. Fiske were the first editors of the new periodical, which first appeared in 1900, and, as was true in the case of the *Bulletin*, they succeeded in establishing notable standards. Moore was editor-in-chief, and to him belongs primarily the credit for this achievement.

During its earlier years the society was the only American mathematical organization of national scope. Consequently its attention was necessarily given to matters of mathematical interest, but not of a research nature, such as college entrance requirements in mathematics, questions of pedagogy, etc. In 1914 determination of whether the society should continue its interest on all levels of mathematical activity or confine itself exclusively to the promotion of research was necessitated by the raising of the question of the relation of the society to the collegiate field covered by the *American Mathematical Monthly*. Early in 1915 the council of the society decided that "it is deemed unwise for the American Mathematical Society to enter into the activities of [this] special field . . . but the Council desires to express its realization of the importance of the work in this field and its value to mathematical science, and to say that should an organization be formed to deal specifically with this work, the Society would entertain toward such an organization only feelings of hearty good will and encouragement." The next year the Mathematical Association of America was founded, and the good-will predicted by the council was immediately realized. The society and the association regularly hold their meetings on successive days in the same location, and joint sessions are frequent.

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[1] It should be mentioned that the organization meeting and over two hundred later meetings were held in the halls of Columbia University, which has also provided the society's office and housed its library. For this hospitality, the society is truly grateful.

In recent years, there has been little fundamental change in the manner in which the society performs its functions. There may be mentioned the establishment in 1923 of the semi-popular Josiah Willard Gibbs lectureship on applied mathematics, this notable series of fourteen lectures being inaugurated in 1924 by the late Professor M. I. Pupin, an early member of the society; the holding of over two hundred invited "hour addresses" since 1921, largely on topics of current research interest; the provision of wider international contacts by means of reciprocity agreements—the first in 1922—with foreign mathematical societies for members of one of the societies to enter the other at reduced rates; the appointment, at the request of the *Annals of Mathematics* in 1926 and of the newly established *Duke Mathematical Journal* in 1935, of associate editors representing the society on the editorial boards of these independent journals; the consummation in 1927 of an agreement with the *American Journal of Mathematics* similar to that sought in 1898, thereby providing additional publication facilities sorely needed; the incorporation of the society under the laws of the District of Columbia in 1923, enabling it better to deal with its manifold financial problem; the extensive growth and increased usefulness of the society's library—particularly strong in relatively obscure journals—especially under the administration of Librarians D. E. Smith (1902–1920) and R. C. Archibald (1921–); the adoption in 1926 of the visiting lectureship plan, by which lectures by a distinguished mathematician are made available at a number of mathematical centers; and the establishment and periodical award of the Bôcher and Cole prizes for mathematical research.

Since 1891 the society has received and expended for society purposes over half a million dollars, well over half of this being derived from membership fees, and much more than three quarters having been spent for publication. In 1891, the year in which publication was first undertaken, the receipts were not quite $975 and the disbursements a little over $700; at present receipts and disbursements are each in the neighborhood of $35,000 per annum. Although the membership has increased tenfold, the expenses have multiplied fiftyfold. The greatest problem of the society through the years has been financial. In its solution, the society has always turned first to its members, who have helped notably in voting from time to time to increase their dues, in contributing to an endowment fund (now amounting to $70,000), in increasing the subscription list of the society's publications and in bringing new members into the society. A plan for patron and sustaining memberships was drawn up, which worked well during years of business prosperity, but failed under the stress of the depression: many of the sustaining memberships were held by commercial companies. The Carnegie Foundation, the General Education Board and the Rockefeller Foundation also helped generously by contributions and subventions. The present source of support beyond individual memberships and subscriptions is in institutional members—largely universities and research institutions—whose dues are calculated in proportion to the annual publications of the members of their staffs in the society's journals.

It is obvious that the transformation of a small local group into a national organization internationally recognized has been accomplished through devoted service; it did not just happen. The society has been especially fortunate in its secretaries: the work of Professor Fiske, the first secretary, has already been mentioned, and it is impossible to overestimate or exaggerate the importance of the zeal, wisdom and unceasing labor of the second secretary, Professor Frank Nelson Cole, of Columbia University, who served from 1895 to 1920. The present secretary, Dean R. G. D. Richardson, of Brown University, who has held office since 1921, and his associates, are worthy successors. The presidents, too, who, with one exception, held office for two years each, have been an able and honored group. Emory McClintock, G. W. Hill, Simon Newcomb and R. S. Woodward, who constitute the succession from 1891 to 1900, all were widely honored outside the circle of their own colleagues. E. H. Moore, Maxime Bôcher, H. B. Fine, E. W. Brown and Frank Morley—to mention among their successors only those no longer living—have likewise been of recognized eminence.

The future, as the past, of the American Mathematical Society depends on the men it will rally to its service. Signs are not wanting that men of talent and devotion are still to be found in its ranks. The society enters its second half century with the strength of a loyal membership, and the inspiration of a noble history—the development of a recognized "American School" of mathematics. Its accomplishments constitute as well a great responsibility. May it prove worthy of its heritage and promise.

OBITUARY

FRED CAMPBELL MEIER

FRED CAMPBELL MEIER, a passenger on the Hawaii Clipper, lost near the Philippines on July 28, was born in Riggston, Ill., on April 5, 1893. His father, W. H. D. Meier, rural schoolmaster and superintendent of schools, moved the family to Framingham, Mass., in 1910, took up work at Harvard and obtained his Ph.D. in 1919. It was only natural, perhaps, that the son should also go to Harvard and that the three daughters in this remarkable family should also go in for advanced academic degrees. Father, son and three daughters are all in the sixth edition of "American Men of Science."

After graduation from Harvard, he served as Austin teaching fellow there for two years, being awarded an A.M. in 1917. In 1918 he was offered a position in the Bureau of Plant Industry, U. S. Department of Agriculture, as assistant pathologist. In about a year he was transferred to the Bureau of Agricultural Economics as pathologist, returning to Plant Industry in 1921. In 1922 he was chosen as extension pathologist of the Office of Cooperative Extension Work investigating diseases of cucurbits. He held this position for eight years. It took him up and down the east coast, from the melon field to the market place. In 1930 the Division of Barberry Eradication was formed, and he was placed in charge. He left this position, however, in 1934 and returned to the Extension Service, which position he held at the time of his death.

From 1929 to 1934 he was secretary-treasurer of the American Phytopathological Society and business manager of its publication, *Phytopathology*. Because of his long association with this society and his extensive travels, he became well acquainted with plant disease control problems throughout the United States. He was a fellow in the American Association for the Advancement of Science, and a member of the Cosmos Club, Torch Club and Botanical Society in Washington.

In addition to his work on plant disease control, Meier will be remembered for his work on his hobby, aerobiology. He was intensely interested in the microbial content of the upper air, spending his own money and his vacations devising apparatus, making collections, photographing slides and studying cultures. He showed an uncanny aptitude in making contacts. Commercial airplane officials, as well as the Army and Navy, cooperated with him and made collections possible from the upper air, not only over land, but along the Atlantic coast and over the Caribbean Sea as well. He persuaded Colonel Lindbergh to aid him in designing a "sky-hook," by which samples of spores in the air were collected by the Lindberghs on their trip to Europe across the North Atlantic. Later Amelia Earhart took his apparatus and was making collections for him on her ill-fated round-the-world flight. This was a severe blow, but it did not discourage him.

As a result of his continued efforts, an Interdivisional Committee in the Life Sciences and the Division of Biology and Agriculture of the National Research Council was appointed in 1937, and Meier was named as chairman. Within a year he had obtained a grant from the National Research Council and the Bureau of Plant Industry, which would enable him to take leave from his official duties in the Extension Service and give two months in the summer of 1938 and four months in the spring of 1939 to this project. Thus at the beginning of the realization of the results of years of thought and effort, when he was really in a position to devote his best efforts to his hobby, his life was suddenly brought to a close. If it had to be, this was a most fitting manner for him to die, engaged in the work he liked best, pioneering in a field that has hardly been touched.

In 1920 he married Agnes W. Eastman, who survives him. He will be missed by a large group of friends, both official and social, who will long remember his unbounded energy and enthusiasm in work or play.

NATHAN R. SMITH

BUREAU OF PLANT INDUSTRY

RECENT DEATHS AND MEMORIALS

VICTOR KING CHESNUT, who had been connected until his retirement in 1933 for thirty-nine years successively as botanist and chemist with the U. S. Department of Agriculture, died on August 29 at the age of seventy-one years.

STUART A. STEPHENSON, professor of mathematics and engineering at Rutgers University, died on September 1 at the age of sixty years.

DR. THOMAS R. BOGGS, associate professor of clinical medicine in the Johns Hopkins University Medical School and physician in chief of the Baltimore City Hospital, died on September 2 in his sixty-third year.

DR. ARTHUR EVERETT AUSTIN, emeritus professor of the theory and practice of medicine at the Medical School of Tufts College, Boston, died on August 22 at the age of seventy-seven years. Dr. Austin specialized in diseases of the digestive tract.

DR. JOHN N. LOWE, associate professor of biology at the Northern State Teachers College at Marquette, Mich., died on July 27 in his fifty-second year.

SIR DAVID WILKIE, since 1924 professor of surgery at the University of Edinburgh, died on August 25. He was fifty-six years old. Sir David was known for research in abdominal surgery.

THE Board of Control of the Michigan College of Mining and Technology has officially named the mining building Sperr Hall in honor of the late Frederick William Sperr, head of the department of mining and civil engineering from 1894 to 1926. Professor Sperr died in November, 1929. The building now named in his memory was designed, erected and equipped under his supervision.

SCIENTIFIC EVENTS

THE PROPOSED DIVERSION OF THE WATERS OF YELLOWSTONE LAKE

PROFESSOR L. G. ROMELL, of Djursholm, secretary of the Swedish Government Committee on Planning and Recreation, who was at one time head of the department of forest soils at Cornell University, recently addressed a letter to Secretary Harold L. Ickes protesting against attempts made in the seventy-fifth Congress to permit diversion of the waters of the Yellowstone Lake for irrigation purposes in the Upper Snake River basin, Idaho.

Professor Romell wrote: "It may not be the business of anybody outside the United States to express himself on the proposed engineering and water diversion project in the heart of the world's oldest national park. However, in a way, the wonderland of Yellowstone belongs to the world. If commercial interests should be allowed to encroach upon Yellowstone Lake it would mean far more than despoliation and would be a terrific blow to the entire national park idea which could not fail to have its repercussions throughout the world."

In reply Secretary Ickes wrote in part:

> I have received your letter of June 24, describing the damaging effects upon national park standards throughout the world that would follow if Congress were to authorize the diversion of waters of Yellowstone Lake for irrigation purposes, proposed in S. 3925 and H. R. 10469, introduced but not acted upon in the last session of the Congress.
>
> It is gratifying to hear from you that Yellowstone National Park is taken as the international model for all national parks. It will be my endeavor to keep it so by opposing the present irrigation project and all proposals tending to break down the integrity of our national park standards. The enjoyment of its magnificent natural wonders is not limited to Americans. Last year alone some 6,400 visitors from 37 foreign countries visited the park.

Recalling that the Congress, in establishing the park in 1872, made it the duty of the Secretary of the Interior to provide "for the preservation, from injury or spoliation, of all timber, mineral deposits, natural curiosities, or wonders within said park, and their retention in the natural condition," Mr. Ickes said: "Like my predecessors I insist that this condition is indispensable if the Yellowstone National Park is to continue to fulfill the purpose for which it was established."

CHANGES OF PERSONNEL IN THE FOOD AND DRUG ADMINISTRATION

A NUMBER of changes have been made in the personnel of the Food and Drug Administration, of which Dr. W. G. Campbell is chief. These are:

Joseph Callaway, Jr., now chief chemist of the Eastern Food and Drug Inspection District, with headquarters at New York, becomes senior chemist to serve as technical assistant and secretary of the reorganized Food Standards Committee of four state food law enforcement officials and two members of the Food and Drug Administration. This committee will consider data on the authentic composition of food materials and formulate standards of identity and reasonable standards of quality and fill of container for various foods.

Roy S. Pruitt, now chief chemist of the New Orleans Food and Drug Inspection Station, also will be transferred to Washington and attached to the office of the chief to handle administrative details of the new cosmetic section of the law.

Dan Dahle, at present associate chemist in the Food Division of the Food and Drug Administration in Washington, who has had long experience in the development of food methods, has been assigned to develop laboratory methods for the analysis of cosmetics and will work in close cooperation with Mr. Pruitt.

Dr. J. J. Durrett, now chief of the Drug Division of the administration in Washington, becomes principal technical adviser and is attached to the office of the chief of the administration. He will share with other officers the responsibility of determining administrative questions on the application of the new law to drugs, devices, special dietary products and cosmetics, and will give special consideration to the adequacy of information submitted by manufacturers with their applications on new drugs filed in compliance with the provisions of the act.

Dr. Theodore G. Klumpp, now senior medical officer of the Drug Division, succeeds Dr. Durrett as chief of that division. Dr. Klumpp is a graduate of Princeton University, received his medical degree at Harvard Medical School in 1928, served his interneship at Peter Bent Brigham Hospital in Boston, was assistant resident physician at Lakeside Hospital, Cleveland, Ohio, instructor at Yale University Medical School, and an associate physician at the New Haven Hospital.

FOOD STANDARDS COMMITTEE OF THE FOOD AND DRUG ADMINISTRATION

SECRETARY OF AGRICULTURE HENRY A. WALLACE has approved the recommendation of the Food and Drug Administration for the appointment in that organization of a Food Standards Committee, which will function under the terms of the Food, Drug and Cosmetic Act of June 25, 1938.

It is the intention of the Food and Drug Administration to perpetuate the food standards committee which has functioned in promulgating administrative standards for the last twenty-five years. This committee has consisted of representatives from the Association of Official Agricultural Chemists, the Association of Dairy, Food and Drug Officials of the United States and the U. S. Department of Agriculture. Members of the committee are:

For the Association of Official Agricultural Chemists: C. D. Howard, director and chief, Division of Chemistry and Sanitation, State Board of Health, Concord, N. H.; Guy G. Frary, state chemist, Vermilion, S. D.

For the Association of Dairy, Food and Drug Officials of the United States: J. J. Taylor, state chemist, Department of Agriculture, Tallahassee, Florida; Mrs. F. C. Dugan, director, Bureau of Foods, Drugs and Hotels, State Board of Health, Louisville, Ky.

For the Food and Drug Administration: W. B. White, chief, Food Division; W. S. Frisbie, chief, Division of State Cooperation.

The work of the committee will be to formulate definitions and standards both of identity and of quality, including fill of container, after consideration of all the data—analytical and inspectional—deemed essential to support them. The committee will meet in the Food and Drug Administration at Washington at intervals to review the data which have been assembled, draft tentative standards, and then upon the conclusion of public hearings, required by the act, make its final recommendations. Under the new act these definitions and standards when promulgated by the Secretary will have the full force and effect of law.

The first committee to consider food standards was one appointed by the Association of Official Agricultural Chemists in 1897. This committee was originally headed by Dr. Harvey W. Wiley. By virtue of the congressional appropriation act of June 3, 1902, the Department of Agriculture was authorized to investigate food standards and the Association of Official Agricultural Chemists committee was named for this purpose. This committee was supplemented in 1905 by the appointment of a representative of the Association of Dairy, Food and Drug Officials. The tripartite form of the committee was established as the result of a general conference between State and Federal food and drug officials held in November, 1913.

THE AMERICAN CONGRESS ON OBSTETRICS AND GYNECOLOGY

THE first American Congress devoted to a consideration of medical, nursing and other problems associated with human reproduction will be held in Cleveland, Ohio, from September 11 to 15, 1939, inclusive. It will be designated the American Congress on Obstetrics and Gynecology. The promotion and sponsorship of the congress has been delegated to the American Committee on Maternal Welfare, which includes the following organizations in its membership:

American Association of Obstetricians, Gynecologists and Abdominal Surgeons.
American College of Surgeons.
American Gynecological Society.
American Hospital Association.
American Nurses Association.
American Protestant Hospital Association.
American Medical Association, Section on Obstetrics and Gynecology.
American Public Health Association.
Central Association of Obstetricians and Gynecologists.
Chicago Maternity Center.
Maternity Center Association of New York.
National Medical Association.
National League of Nursing.
National Organization for Public Health Nursing.
New England Obstetrical and Gynecological Society.
Pacific Coast Society of Obstetrics and Gynecology.
Southern Medical Association.
U. S. Bureau of the Census.
U. S. Children's Bureau.
U. S. Public Health Service.

The purpose of the congress is to afford opportunities for discussing and publicizing the problems associated with human reproduction and the health of women and new-born babies. The value of more generally disseminated knowledge about the processes and problems of human reproduction and of the special diseases of the female generative organs and of the new-born is important in the maintenance of public health and therefore the interest of woman's welfare extends not only to the medical profession but to associated groups, including nurses, public health officials, hospital administrators, eugenists and many others.

The last International Congress of Obstetrics and Gynecology was held in Amsterdam in May of the present year. Its success stimulated a desire to hold a subsequent one in five years in another European country. It is felt that the difficulties associated with an international assembly, such as languages, expense, long distance travel and limited participation, lack of common interest, call for a regional gathering in which opportunities for more general discussions would prevail. The proposed American congress will therefore be modeled on different lines and includes participation not only by medical groups but by those devoted, as already stated, to nursing, public health and institutional administration.

In addition to the scientific sessions it is planned to provide for several evening meetings at which speakers of prominence will discuss the broader aspects of the subjects for the lay public. There will also be prepared a comprehensive exhibit—scientific, educational, technical and commercial.

Members of the executive committee are: Fred L. Adair, Chicago, *general chairman;* Robert D. Mussey, Rochester, Minnesota, *vice-chairman;* Sara B. Place, Chicago, *secretary;* Rudolph W. Holmes, Chicago, *treasurer,* and Frederick H. Falls, Chicago, *assistant treasurer.*

National, sectional and local specialist societies have approved the congress and have made contributions for its support. It is desired that a wider representation be secured through the medium of contributing memberships, the cost of which has been placed at five dollars. Application may be made at the office of the congress at 650 Rush Street, Chicago, Illinois.

SYMPOSIUM TO COMMEMORATE THE CENTENARY OF THE CELL THEORY

IT has been decided to hold a symposium at the Richmond meeting of the American Association for the Advancement of Science, Sections L, G and F collaborating, to commemorate the centenary of the cell theory. The major lines of this symposium have been determined as follows:

a. Four to six papers are to be presented by men of sound judgment and thorough knowledge of the facts, so that the symposium may represent an outstanding contribution to the history of the subject.

b. Biographical accounts are to be limited though not omitted; a broader base than the work of Schleiden and Schwann alone will be looked for in developing the foundations of the theory (by including the work of such a man as Purkinje); and stress will be laid upon what the cell theory is to-day.

The program for this symposium is in process of being developed by the chairmen and secretaries of sections F, G and L and by other officers of the association. At the same time, it has seemed desirable to appeal through the pages of SCIENCE to all scholars who may be interested in the symposium for further suggestions, particularly for the names of outstanding men who might be invited to participate.

The Mexican Society of Natural History is offering awards for the best scientific papers celebrating the centenary of the foundation of the cellular theory and will publish a commemorative volume. Papers presented in the symposium of the American Association for the Advancement of Science in Richmond can presumably be submitted for these awards also, and for a place in the commemorative volume, if that seems desired.

Please send suggestions either to the permanent secretary of the association or to the undersigned, Dr. Joseph Mayer, Secretary of Section L, Library of Congress, Washington, D. C.

JOSEPH MAYER

SCIENTIFIC NOTES AND NEWS

SIR ALBERT SEWARD, from 1906 to 1936 professor of botany at the University of Cambridge, was elected president of the British Association for the Advancement of Science at the Cambridge meeting. Sir Albert was master of Downing College, Cambridge, from 1915 to 1936, and was vice chancellor of the university from 1924 to 1926. Two members of the council were elected, Dr. Charles E. Spearman, emeritus professor of psychology at the University of London, and Dr. C. R. Fay, reader in economic history at the University of Cambridge. The meeting in 1939 will be held at Dundee. The places of meeting for 1940, 1941 and 1942 will be Newcastle, Belfast and Birmingham.

DR. MAJOR GREENWOOD, professor of epidemiology and vital statistics at the School of Hygiene and Tropical Medicine of the University of London, has been awarded the Bisset Hawkins Gold Medal of the Royal College of Physicians for his researches in statistics.

Nature reports that the joint committee of representatives of the Royal Society of Edinburgh, the Royal Physical Society and the Royal Scottish Geographical Society has awarded the Bruce Memorial Prize (1938) to Alexander R. Glen for his work in Spitsbergen, including survey in New Friesland and the completion of the map of North East Land. The council of the Royal Society of Edinburgh has awarded the David Anderson-Berry Prize (1938) to Miss Mary A. C. Cowell, of the Holt Radium Institute, Manchester, for her essay entitled "An Investigation into some of the Factors affecting the Response of Human Skin and Human Skin Tumours to Radiation."

AT the annual dinner on August 31 of the San Francisco meeting of the American Society of Bacteriologists Dr. Jerome T. Syverton, assistant professor of bacteriology at the University of Rochester, in recognition of his work on filterable viruses, was presented with the prize of $1,000 and a medal, founded by Eli Lilly and Company. The award is given annually to an investigator under thirty-one years of age who has made outstanding contributions to knowledge in the fields of bacteriology and immunology.

DR. WALLACE E. HERRELL, of the Mayo Foundation, has received the first award of the Foundation Prize of the Association of Obstetricians, Gynecologists and Abdominal Surgeons. His paper, entitled "Studies of the endometrium in association with the normal menstrual cycle, with ovarian dysfunctions and with cancer of the uterus," will be presented on September 24 at the fifty-first annual meeting of the society at White Sulphur Springs, W. Va.

PROFESSOR ALFRED REHDER, of the Arnold Arboretum, Harvard University, celebrated his seventy-fifth birthday on September 4. In appreciation of his conspicuous services over a period of forty years to horticulture, dendrology, systematic botany and botanical bibliography, the staff tendered a dinner to him and to Mrs. Rehder on the evening of September 1. During the course of the dinner, Professor Rehder was presented with a substantial purse provided by members of the committee appointed by the Corporation of Harvard University to visit the Arnold Arboretum and by his associates.

DR. WALTER ANDREW BLOEDORN, assistant dean of the School of Medicine of the George Washington University and medical director of the university hospital, has been appointed acting dean of the School of Medicine.

DR. CHARLES E. PALM, assistant professor of entomology at Cornell University, has been appointed head of the department of entomology to succeed Professor O. A. Johannsen, who retired on July 1.

THE REV. DR. HILARY JURICA, professor of biology at St. Procopius College, Lisle, Ill., has been appointed head of the department of biology at DePaul University, Chicago, beginning in June, 1939. Until then he will be consulting head *in absentia,* and Professor F. A. Varrelman will be acting head of the department.

DR. EARLE B. PERKINS, professor of zoology and Antarctic explorer, has been appointed head of a newly established department of biophotography at Rutgers University. The department will continue on an enlarged scale the photographic research of the late Norman McClintock, photo-naturalist, who died early this year. The directional functions of the University Committee on Photographic Research in Biology will be taken over by Dr. Perkins. The department will undertake the production of instructional motion pictures of college grade in the field of biology and related subjects (botany, surgery, medicine, veterinary science and psychology), and the use of the motion picture camera as a research tool in the analysis of biological problems.

DR. CHILTON A. WRIGHT, of Washington, D. C., has been appointed professor of sanitary and hydraulic engineering at the Polytechnic Institute, Brooklyn, N. Y.

DR. RUSSELL H. LYDDANE has been appointed assistant professor of physics in the University of North Carolina. He will take the place of Professor Otto Stuhlman, Jr., while the latter is on sabbatical leave. Dr. J. B. Fisk has been appointed associate professor.

DR. ROMAN KENK, extraordinary professor of zoology at the University of Ljubljana, Yugoslavia, has been appointed associate professor at the department of biology of the University of Puerto Rico.

THE Paris correspondent of the *Journal* of the American Medical Association reports that Professor Fernand Bezançon, phthisiologist, and Professor Marion, urologist, of the University of Paris, retired at the close of the academic year. In their case the law which now requires the retirement of university professors at the age of sixty-five years was modified so that they would not be obliged to retire until they had reached the age of seventy years.

THE Buhl Foundation grant for research in biochemistry has been renewed for the college year 1938–39 for studies on vitamin C, tissue respiration and molecular structure in the department of chemistry of the University of Pittsburgh. The following are the appointees under the renewed grant: Research fellows: Max O. Schultze, Ph.D., Wisconsin, animal nutrition and tissue respiration; Rade R. Musulin, Ph.D., Pittsburgh, animal nutrition, and Herbert E. Longenecker, Ph.D., Pennsylvania State College, the molecular structure of fats. Research assistants: Carter J. Harrer, B.S., Pittsburgh, tissue respiration; Theodore H. Clarke, B.S. Chem., Pittsburgh, the molecular structure of fats and sugars; Mary L. Dodds, B.S. Chem. and M.S., Pittsburgh, tissue respiration. The work on heats of combustion in relation to molecular structure will be under the supervision of Dr. Gebhard Stegeman, professor of physical chemistry. Dr. Charles Glen King, professor of biological chemistry, is director of the general project.

PROFESSOR H. J. CHANNON, professor of biochemistry at the University of Liverpool, has been appointed by the British Secretary of State for the Colonies member of a commission to visit the Malay Straits to survey existing arrangements for higher education, general and professional.

DR. MALCOLM H. SOULE, professor of bacteriology and director of the Laboratory of Hygiene of the University of Michigan, secretary of the Section of the Medical Sciences of the American Association for the Advancement of Science, has been appointed a delegate from the association to the Malaria Congress to be held in Amsterdam from September 23 to October 1.

PROFESSOR W. K. GREGORY, curator of comparative anatomy at the American Museum of Natural History and professor of paleontology at Columbia University, accompanied by Dr. Milo Hellman, professor of dentistry at the university, arrived in New York from South Africa on September 3. The visit was made at the request of Dr. Robert Broom, curator of anthropology at the Pretoria Museum, and Professor Raymond Dart, of Witwatersrand University, Johannesburg. Studies were made of the fossil skulls of anthropoid apes found in South Africa.

Dr. Wilbur A. Sawyer, director of the International Health Division of the Rockefeller Foundation, left on September 2 for Bogota, Colombia, where he represented the United States and the Rockefeller Foundation at the Pan-American Sanitary Conference, which opened on September 4. Dr. Sawyer made the entire trip by air.

Dr. Waltman Walters, professor of surgery at the Mayo Foundation, left Rochester, Minn., for a visit to Europe on September 4. He plans to read a paper before the meeting of the International Society of Surgery, which will be held in Brussels from September 19 to 22. He will also speak at the meeting of the French Urological Congress in Paris, which is being held from October 6 to 8. Later Dr. Walters will spend about three weeks in Great Britain, returning to the Mayo Clinic on November 7.

Dr. Elliott P. Joslin, emeritus professor of clinical medicine at the Harvard Medical School, delivered the two Malthe lectures and conducted a clinic in Oslo on September 5, 6 and 7; he will participate in a symposium on protamine insulin with Dr. H. C. Hagedorn, of Copenhagen, and Dr. Wilhelm Falta, of Vienna, before the Gesellschaft für Verdauungs- und Stoffwechsel-Krankheiten in Stuttgart on September 23.

The Collecting Net reports that Dr. Gregory Clarke, of Harvard University and the Woods Hole Oceanographic Institution, has leave of absence from the institution for three months to study the techniques used in fresh water lakes with a view to determining their application to marine conditions. Dr. Clark is now with Dr. Juday, who is director of the Trout Lake Limnological Laboratory in Wisconsin.

The Australian and New Zealand Association for the Advancement of Science announces that H. G. Wells; Sir John Flett, until his retirement in 1935 director of the Geological Survey of Great Britain and of the Museum of Practical Geology, London; F. T. Brooks, professor of botany at the University of Cambridge, and Dr. Nevil Vincent Sidgwick, professor of chemistry at the University of Oxford, have accepted invitations to attend the meeting in Canberra next January.

Dr. H. W. Gillett, metallurgist at the Battelle Memorial Institute, Columbus, Ohio, will deliver the 1939 Howe Memorial Lecture of the American Institute of Mining and Metallurgical Engineers.

According to *Nature* the Polish journal *Acta Astronomica*, in its July issue, states that the following members of the staff of the Pulkovo Observatory have been imprisoned: I. A. Balanovsky, N. I. Dneprovsky, B. P. Gerasimovič (director), P. I. Iaschnoff, B. W. Noumeroff (director of the Astronomical Institute at Leningrad, who is believed to have been shot) and N. W. Zimmermann.

Examinations are announced by the U. S. Civil Service Commission for vacancies in the various government departments in the field of physics. Examples of positions known to exist at the present time are: Principal physicist (high voltage therapeutic equipment), National Institute of Health, Treasury Department; associate physicist (electro-acoustics), Bureau of Mines, Department of the Interior, College Park, Md; and associate biochemist (radiation), Division of Industrial Hygiene, National Institute of Health, Treasury Department, Washington, D. C. There is a vacancy in the Bureau of Mines at Pittsburgh in the position of mineral economist. The salaries attached to these positions are as follows: Principal physicist, $5,600 a year; senior physicist, $4,600; physicist, $3,800; associate physicist, $3,200; assistant physicist, $2,600; junior physicist, $2,000; mineral economist (non-ferrous secondary metals), $3,800.

The annual meeting of the American Society of Zoologists will be held in Richmond, Va., on December 28, 29 and 30. All sessions for the reading of papers and for demonstrations will be held at the Medical College of Virginia, which is centrally located in Richmond. Members of the society, who wish to present papers at the Richmond meeting, should send titles and abstracts to E. G. Butler, secretary, Princeton University, on or before November 1.

The twenty-sixth annual meeting of the American Association of Cereal Chemists will be held in Kansas City, Mo., from May 15 to 19, 1939. The association, which was organized in Kansas City in 1914, last met there in 1929. It is composed of chemists in the milling, baking, brewing and allied industries. The president for the current year is Dr. W. F. Geddes, of the Canadian Grain Research Laboratory, Winnipeg.

The summer meeting of the Plant Taxonomists of the Indiana Academy of Science opened at Bass Lake, Indiana, on September 2 and lasted for four days. Field trips were made to various lakes and other points of interest to botanists in the northwest part of the state. The plant taxonomists of the Michigan Academy of Science were invited guests at the meeting.

DISCUSSION

ISOLATION OF URACIL FROM LIVER

In the course of a fractionation procedure designed for the isolation of one of the water-soluble vitamins from liver extract, a crystalline compound was obtained which was identified as uracil. Because we have been unable to find a report of the presence of free uracil in liver and because of the rather unusual, yet simple method that yielded the pure material, it may be of use to other workers to record our observations briefly.

A commercial alcohol-soluble fraction of pork liver extract obtained as a by-product in the preparation of the pernicious anemia factor was used as a starting material.[1] This sirup was dissolved in water, concentrated under reduced pressure, adjusted to a pH between 6 and 7, and extracted continuously with ether for 75 hours. A pale yellow, crystalline deposit slowly formed in the boiling flask during this time. These crystals were filtered off and recrystallized from water. The resulting white product gave a strong test for uracil when treated with bromine water and barium hydroxide, and contained 25.3 per cent. nitrogen (calculated for uracil, 25.1 per cent.). The phenylhydrazine derivative prepared according to Levene's directions[2] melted at 250°; 5-phenylhydrazine-uracil melts at 252°. The yield amounted to 0.007 per cent. of the fresh liver.

These facts leave no doubt as to the presence of uracil in the liver extract. However, it may be possible that the pyrimidine was an artifact, and that it arose from cytosine during preparation of the extract. Since enzyme action is rapid, artifacts may conceivably arise even in the relatively short time required to make an aqueous extract of the organ.

Similar procedures applied to rice bran extract have resulted in the isolation of uracil from this material also.

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FACETTED PEBBLES IN EASTERN VENEZUELA

In the southwest part of the state of Anzoategui, in eastern Venezuela, there are extensive areas of rolling savanna land, covered by coarse grass and a thin growth of scrubby trees; with the drainage courses marked by narrow bands of dense tree growth. The surface is composed of late Tertiary sand and clay; and over much of the area there is a sprinkling of pebbles, concentrated by erosion as a lag gravel from some of the sandy beds. Nearly all these pebbles are of quartz, well-rounded; with occasional less-rounded fragments of chert. The greater number range from about one-half inch to two inches in greatest dimension.

Scattered among these rounded pebbles there are also facetted pebbles of quartz, with rarely a facetted chert pebble. Many are well-formed dreikanters, with triangular cross section and lens-shaped sides. Occasional pebbles, oval in general shape, have only one well-developed edge. A greater number of pebbles show only partial facetting. Their frequency varies considerably in different localities, perhaps having been governed by favorable exposure to the prevailing wind. A rough analysis of groups of 200 pebbles, gathered from eight widely separated localities, is given in Table I.

TABLE I

Locality	A	B	C	D	E	F	G	H
Good specimens	0	1	2	2	2	3	5	12
Partially facetted	1	5	3	4	8	4	24	22
Some facetting	4	8	5	10	22	9	28	31
Not appreciably facetted.	195	186	190	184	168	184	143	135

The two localities showing greatest frequency of facetting are on opposite sides of the valley of the Aribi River, on upland benches; the other localities are at places on the savanna lands not especially exposed to the wind.

Since they were facetted most of the pebbles have acquired a rust-colored film from the sandy soil. Some on stream terraces are clear white, but their edges are somewhat rounded, as if they had undergone partial re-rounding since being facetted.

In many places the surficial material has been cemented by iron oxide into hard sandstone and conglomerate; which, by differential erosion, now cap low mounds, knolls and even hills, rising above the mean level of the savanna lands. The pebbles in the conglomerate are so like those of the lag gravel that it seems probable they all have a common origin.

In a few places where blocks of the conglomerate are exposed to winds from the east or southeast, the surface pebbles have been polished, and even worn into curved surfaces; but an unsuccessful search was made for facetted pebbles embedded in the conglomerate. It would seem, therefore, that the conglomerate was formed prior to the period of facetting, and also in some places underwent sand-blasting.

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[1] We wish to thank Dr. David Klein of the Wilson Laboratories for generous gifts of this material.

[2] P. A. Levene, *Jour. Biol. Chem.*, 63: 658, 1925.

The region now has a mean annual rainfall in excess of fifty inches, and is not subject to high winds carrying sand. It seems probable that the facetted pebbles indicate a former period of aridity which occurred after the lag gravel was formed, perhaps sometime during the Quaternary period.

G. A. WARING

ITHACA, N. Y.

LEE C. ARMSTRONG

MINNEAPOLIS, MINN.

ISOTOPES OF URANIUM AND LEAD

THE *Science News Letter* item on Dr. Nier's work[1] in its headlines at least rather ignores the preceding work, preliminary to Dr. Nier's brilliant papers. That "lead atoms may yield clues to very old earth's history" and that in ordinary uranium there are two kinds of atoms with different atomic weight, yielding leads of different atomic weights, was argued by T. R. Wilkins as far back as 1926,[2] and, as he suggested, then in early days there would have been not merely more uranium, but a larger proportion of the more quickly decaying uranium isotope—actinouranium, and hence in the older uraniferous minerals the radiogenic lead would have more of that isotope, specifically Pb (207).

Though for some time there has been fair agreement as to the rate at which actinium (which yields Pb 207) and radium (which yields Pb 206) were being formed at present, there has not been agreement as to the relative *amounts* of the isotopes and hence of the relative decay constants of UI and AcU.

Wilkins's point of view has been strongly supported by A. v. Grosse, who drew a curve connecting the age of a lead with the proportion of Pb (206) to Pb (207), and John L. Rose[3] estimated the proportions by strength of the spectral lines and also gave curves to estimate age. Dempster also made a preliminary estimate of the proportions of the uranium isotopes.

There has, however, been a uniformity in the atomic weight of radiogenic lead, not easy to explain,[4] and it has been not easy to tell how much ordinary lead might be mixed in.

Dr. Nier's success in recognizing the amount of ordinary lead by the amount of Pb 204 present, and in getting the various isotopes not only of lead but uranium with much greater accuracy than before and from much smaller quantities, ten milligrams or less, is a great step in advance and puts age determinations by lead on a sounder basis, and the variation of the proportions of isotopes in what has been supposed to be ordinary lead makes it not needful to suppose a common source for all of it. The identification of Pb (204) as characteristic of common lead enables one to allow for it.

The report of the committee on the measurement of geological time will not be out until next fall, I regret to say. Thus, I think this note of explanation desirable, so that the important work of Nier toward settling the important controversies started by v. Grosse and Holmes may not be minimized, and yet the fact recognized that it is supported by and a continuation of the pioneer work of Wilkins and others.

ALFRED C. LANE

JULY 11, 1938

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[1] June 18, 1938, p. 392; SCIENCE, Supplement, p. 10, June 10, 1938.

[2] *Nature*, 117: 719–720, 1926; *Phys. Rev.* (2) 29: 852, 1927; *Bull. Geol. Soc.*, 38: 124, 1927.

[3] John L. Rose and R. K. Stranathan, "Geologic Time and Isotopic Composition of Radiogenic Lead," pp. 792–6 (1936), with references to previous work.

[4] A. Holmes, "Age of the Earth" (3rd ed.), pp. 151–153; *Ec. Geol.*, 32: 763–782, 1937.

AUTHORITY CITATIONS IN BIOLOGICAL NOMENCLATURE

THE protest[1] against dual authority citations as now prevalent in American botanical literature is well taken. Unfortunately the author raises the question, What authority should be used, the original describer of the species or the maker of the generic-specific combination? Generic-specific combinations change every twenty years. Zoologists have been using for decades, with apparent satisfaction, the original describer. Thus that system must be quite usable and is far more stable.

As a matter of fact, the majority of biologists have no use for the authority because the old original descriptions are extremely meager and lack comparative data. Manuals and recent monographs are used by the great majority of biologists. Only the highly specialized systematist consults the old original descriptions, and he does not need to know under what genus any one species originally appeared, as he has the page citation and the series number of the species in his catalogue. Moreover, one hundred years hence these ancient citations will no longer be consulted.

Many of the old authorities are of no practical importance; they are of historical interest. A real contribution to the advancement of nomenclature would be to discard the original authority and supplant it by reference to the best description, including the best set of figures—which would usually be the latest family or generic monograph of the species in question. In such a monograph the historically minded biologist would find all necessary references to the original and primitive descriptions.

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[1] SCIENCE, 88: 128, August 5, 1938.

SPECIAL ARTICLES

INDUCTION BY FAST NEUTRONS OF MUTATIONS IN ANTIRRHINUM AND MYOSOTIS[1]

In a recent paper[2] the author has shown that variations in germination as well as in the external morphology of some plants result from bombarding dry seeds with fast neutrons. It is now possible to record changes in flower color and flower form observed in the same plants.

To recapitulate briefly: seeds of six different genera with very small seeds were put into gelatin capsules, the latter were placed in turn in a lead box (8 × 8 × 6 cm) whose centimeter thick walls were lined inside with a 2 mm layer of paraffin. The box and its contents were laid on a metal shelf attached to the outside of the cyclotron "tank" so as to be close to the bombarding chamber, but at a distance of about 60 cm from the target. In this way the seeds could absorb only stray emanations from the cyclotron, whenever it was in operation, during the three months in which these experiments were conducted.

The most conspicuous results with respect to changes in flower color and flower morphology were seen in the cultures of *Antirrhinum* and *Myosotis*. The former showed more marked color changes, whereas in the latter morphological variations were more frequently found.

The seeds from which the *Antirrhinum* and *Myosotis* cultures were grown were exposed to the stray neutrons during part of the time through a period of six weeks. Other seeds in the same experiments (1) were subjected to the bombardment for periods ranging from one to nine weeks. In the case of the snapdragon cultures, controls and treated seeds were grown from the same seed capsule.

Myosotis flowers showed conspicuous alterations in their morphology. The various deformations and anomalies were as follows:

(1) Twisted petals
(2) Cleft petals
(3) Fused petals
(4) Increase in number of petals
(5) Decrease in number of petals
(6) Different-sized petals
(7) Decrease in number of sepals

The anomalies were often separate on different flowers or occurred in combination with one another, for example, (1) 8 petals, fused at the base, some of which were small and others very large; (2) 5 petals fused, 3 sepals; (3) 5 petals and 4 sepals; (4) 2 large, separate petals, 2 fused, and 3 sepals; or (5) 3 petals and 3 sepals.

"A Dictionary of Color"[3] was used to identify the flower colors and to record them for future reference. Colors given in parentheses indicate the names which the author used for identification in the greenhouse as they were often more descriptive than those given in the dictionary.

Variations in floral color in *Myosotis* were not marked, although in two plants there were "orchid" (pinkish-purple) flowers.

Three groups of *Antirrhinum* were grown from treated seed, and there were controls for each set as well. For Culture 1 the normal color was yellow L1 plate 10 (lemon yellow), for Culture 2 cerise (rose pink) and for Culture 3 was burnt orange (orange bronze).

In Culture 1 there were no observable differences from the controls except that the individual blossoms were slightly reduced in size.

The greatest color variations from the normal controls were found in Culture 2 and these variations with the percentage of plants having these differences were as follows:

(1) cerise (rose pink)—normal color	48.2	per	cent.
(2) pink "5T" (light pink)	5.5	"	"
(3) pink "1T" (pink white)	.8	"	"
(4) magenta (lavender)	1.6	"	"
(5) burnt orange (orange bronze)	34.7	"	"
(6) bittersweet (light bronze)	9.2	"	"

Of the total it is seen that 54.5 per cent. of the plants were either like the normal (cerise) or but slightly different from it (pink "5T" and pink "1T"), 43.9 per cent. were bronze-like, and only 1.6 per cent. were lavender. With the exception of the lavender flowers, which were smaller, the blossoms of this culture were about equal in size with the controls.

Culture 3 likewise showed marked variations from the normal color. The variants and the percentage of plants in the culture which were normal and which were different from the control are indicated as follows:

(1) burnt orange (orange bronze)—normal color	54.1	per	cent.
(2) bittersweet (light bronze)	29.1	"	"
(3) yellow L1 plate 10 (canary yellow)	4.1	"	"
(4) spinel rose (pink)	12.7	"	"

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[1] Papers from the Department of Botany of the University of Michigan, No. 663.

[2] R. M. Chatters, Science, 87: 262–263, 1938.

[3] A. Maerz and P. M. Rea, "Dictionary of Color," McGraw-Hill Company, New York, 1930.

Here again the majority of the plants were like the controls in flower color (orange bronze) or a slight variation from it (light bronze).

Colored photographs of the floral variants and their controls have been made on "Kodachrom" film by Mr. Ralph Bennett, of the University of Michigan Department of Botany. Solutions containing the pigments from the flowers of the *Antirrhinum* cultures have been photographed in color by Dr. O. L. Inman, of the C. F. Kettering Foundation at Antioch College.

Seeds from a number of the anomalous plants have been collected and will be sown to obtain further data on the genetical effects of the bombardments on dry seeds.

All exposures were made with the University of Michigan cyclotron, which is supported by the Horace H. and Mary A. Rackham fund. The author wishes again to thank Professor J. M. Cork and Dr. R. L. Thornton for their assistance.

Summarizing: Some plants grown from dry seeds which had been exposed to stray neutrons from the cyclotron have given rise to flowers which are different in color and in morphology from their controls. It is hoped that the genetic relations of the new types may be determined through further experimentation.

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REVERSIBLE INACTIVATION OF PHOSPHATASE

A study has been made of the effect of various oxidation and reduction systems on the activity of the enzyme phosphatase. It has been found that the activity of a potent enzyme preparation can be decreased to one tenth its initial value by reduction with hydrogen, using platinized or palladized asbestos as catalyst. The activity of the enzyme can be completely restored to its initial value by molecular oxygen in the presence of the same catalyst. The original enzyme preparation is as active in nitrogen as in air or oxygen, showing that oxygen is not essential for the activity of the enzyme. Treatment of the original enzyme preparation with oxygen in the presence of platinized asbestos was also without significant effect.

The enzyme, inactivated by hydrogen and the catalyst, remained inactive when the hydrogen was replaced by nitrogen, showing that the reduced enzyme, and not the hydrogen, was responsible for the inactivity.

Although it was found possible to inactivate the enzyme by reducing agents other than hydrogen, reactivation of the enzyme in these cases by oxidizing agents has not been achieved. Reducing agents, such as cysteine, cyanide and ascorbic acid, inhibited the activity of the enzyme in the order named. The inhibiting action of ascorbic acid was slight and detectable only in concentrations above 0.01 molar. The effect of various reversible dyes on the activity of the enzyme was studied. Anthraquinone β-sulfonate, phenosafranine, indigo-tetrasulfonate and methylene blue were without effect in their oxidized states. In their reduced states, however, they caused irreversible inactivation of the enzyme, the degree of inactivation depending upon the oxidation-reduction potential of the dye. The more negative the E'_0 of the dye, the greater was its inhibiting effect. The semiquinones of anthraquinone β-sulfonate and phenosafranine were slightly less active than the completely reduced dyes.

The phosphatase was prepared from beef kidneys by autolysis and repeated fractional precipitation, modified after the method of Albers. The enzyme exerted its greatest activity at pH 9.2. Though the enzyme preparations were of high activity, they were by no means pure. Tested by electrophoresis in the Tiselius apparatus,[1] the most active preparations contained at least three demonstrable protein components. The isoelectric point of the active component, measured in acetate buffer, ionic strength = 0.10, at 1° C., was pH 4.5 ± 0.1.

The experiments reported herein were carried out at 35° C. and pH 9.0 using glycine or veronal as buffer. β-glycerophosphate was used as substrate. $MgSO_4$, in a final concentration of 0.0007 molar, was present in all experiments. Phosphates were usually determined colorimetrically by the method of Fiske and SubbaRow, and also, in some cases, gravimetrically by the method of von Lorenz.

The protocol of a typical experiment demonstrating the reversible inactivation with hydrogen and oxygen follows:

0.05 mg enzyme in 30 cc solution
Substrate: glycerophosphate, 0.003 molar
Buffer: glycocoll, 0.017 molar, pH 9.0
$MgSO_4$: 0.0007 molar
Pt-asbestos present as catalyst

	Initial treatment 20 min.	Subsequent treatment 15 min.	Inorganic P released in 10 min. at 35° mg
(1)	..	..	0.765
(2)	N_2	N_2	0.755
(3)	O_2	N_2	0.780
(4)	H_2	N_2	0.105
(5)	H_2	O_2	0.740

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[1] The use of the Tiselius apparatus was made possible through the kindness of Dr. Ronald Ferry.

THE ISOLATION OF A CRYSTALLINE COMPOUND WITH VITAMIN K ACTIVITY

AN oil, very active in Vitamin K properties, has been obtained by the fractionation of a petroleum ether extract of alfalfa leaf meal. This oil, containing crystals in suspension, was dissolved in a mixture of benzene and absolute alcohol and allowed to stand at - 5° C. The crystalline material which separated was recrystallized from a mixture of benzene and absolute alcohol, then from absolute alcohol, then from acetone and finally from absolute alcohol. The crystals, M.P. 69° C., were small, well-formed, transparent, colorless plates. The chick unit as determined by the procedure developed in this laboratory[1] is approximately 0.6 microgram.

Although it is possible that the activity of these crystals may be due to (1) formation of mixed crystals of the vitamin and an inert substance or (2) adsorption of the vitamin on the crystals, we believe that the crystals are really Vitamin K for the following reasons. These crystals have a greater potency than any other fraction that we have obtained, including the oil from which the crystals were separated. Moreover, the crystals were recrystallized from a variety of solvents without loss of potency.

We have also obtained certain indications that more than one substance possessing Vitamin K activity may be present in our extracts.

Our work is being continued, and the detailed data will be published in a subsequent contribution.

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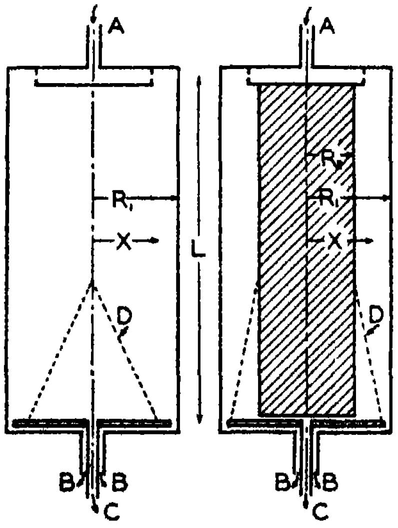
SCIENTIFIC APPARATUS AND LABORATORY METHODS

CENTRIFUGING OF LIQUIDS

IN a previous article[1] a tubular vacuum-type centrifuge was described which has proven to be a very useful tool for the separation of comparatively large quantities of substances. Hence it may be of interest to mention briefly a rather simple change in the design of the spinning tube which has considerably increased its efficiency. The apparatus consists of a tube that is spun to a high rotational speed inside an evacuated chamber. The vacuum around the rotor avoids heating due to air friction and insures absence of troublesome temperature gradients that cause stirring. Fig. 1a shows a schematic diagram of the tubular rotor. For the method of mounting and spinning this rotor, reference should be made to the previous article.[1] The material to be centrifuged entered the spinning hollow tube at A at a continuous rate and the lighter and heavier fractions were collected at C and B, respectively. The separation took place as the material flowed down the length L of the spinning tube. It can easily be seen that for a given material and rotational speed the amount of separation increases with increasing radius of the tube, increasing L, and decreasing rate of flow of the material; *i.e.*, the radius of the tube and the time the material is in the centrifuge. By definition[2] of the sedimentation constant s, the rate of settling of the heavier substance toward the periphery $\frac{dx}{dt} = w^2sx$ where w is the angular velocity of the centrifuge and x the distance of the material from the axis of the tube. Hence $\frac{dx}{dt} = o$ when $x = o$, and in the absence of diffusion the separation would be very small near the center. To overcome this we have been using for some time a solid cylinder in the center of the tube as shown shaded in Fig. 1b. R_1–R_2 is made comparatively small and D is a wire cloth filter to prevent possible remixing at the exits. With this arrangement the material is always in a strong centrifugal field and the



(a) FIG. 1 (b)

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[1] S. A. Thayer, D. W. MacCorquodale, R. W. McKee and E. A. Doisy, *Jour. Biol. Chem.*, 123: cxx, 1938.

[1] Beams, Linke and Skarstrom, SCIENCE, 86: 293, 1937; Beams, *Phys. Rev.*, 53: 850, 1938.

[2] Svedberg, "Colloid Chemistry."

separation is much faster. The volume of the centrifuge is, of course, decreased, which decreases the time that the material is in the centrifuge, but a simple calculation shows that this decrease in time is much more than compensated for by the increase of the average centrifugal field. Experimental tests also show a large increase in efficiency.

In addition to the purification of materials by the continuous flow vacuum-type tubular centrifuge, it is possible at the same time to determine the sedimentation constant s from a knowledge of the dimensions of the centrifuge, rate of flow of material, the ratio of the amounts of the light and heavy fractions and the ratio of the concentrations of the original material and the light and heavy fractions. From a knowledge of s and the diffusion constant, the molecular weight may be obtained.[2] As yet extremely high accuracy has not been obtained, but the results are reproducible with precision. Since the molecular weights of substances from about 40 up to 20,000,000 have previously been measured with precision principally by Svedberg and his collaborators,[3] these materials with known molecular weights can be used to calibrate a particular vacuum-type tubular centrifuge. After once calibrated, the apparatus should give comparatively precise results, especially for high molecular weight substances.

It is a pleasure to record my indebtedness to the Division of Natural Sciences of the Rockefeller Foundation for a grant that has made possible the development of the tubular vacuum-type centrifuge.

J. W. BEAMS

THE VELOCITY OF SOUND

THE velocity of sound has usually been measured over long distances (one to twenty miles) by means of guns and stop watches. With the invention of the oscilloscope, it is possible accurately to measure intervals of time as short as one millionth of a second. Therefore, the velocity of sound may be measured with a baseline less than one foot. As a base line so short can not be determined accurately, a longer base line should be used. Since the standard current alternates sixty times per second, one complete cycle of the current represents one sixtieth of a second. The horizontal plates of a standard oscilloscope are connected to the alternating current, which at the same time causes a loud speaker to emit sixty pulses per second. These sound pulses are received on a microphone which is connected through an amplifier to the vertical deflection plates of the same oscilloscope. The electric impulses received by all four plates must be in synchronism; hence a single line appears on the oscilloscopic screen. If the microphone is moved through approximately twenty feet, the line on the oscilloscope will move through one cycle or one sixtieth of a second. The product of 20 and 60 gives 1,200 feet for the velocity. Careful measurements give the actual velocity 331.57 meters per second at 0° C.

This method may be improved by receiving the impulses alternately upon two microphones through the use of a double pole switch. This obviates the necessity of moving a single microphone twenty feet for each observation.

Accurate measurements can be made over shorter distances by using a continuous sound source instead of a succession of impulses. The sound received in the microphone then sets up a series of sinusoidal waves upon the oscilloscope screen. The microphone is moved until one wave passes across the reference line. In this way both the wave-length and the velocity are determined at the same time.

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A. W. FRIEND

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BOOKS RECEIVED

ALLEE, W. C. *The Social Life of Animals.* Pp. 293. 6 plates. 49 figures. Norton. $3.00.

ALLEN, GLOVER M. *The Mammals of China and Mongolia.* Vol. XI, Part 1 of *Natural History of Central Asia.* Pp. xxv + 620. 9 plates. 23 figures. Central Asiatic Expeditions, American Museum of Natural History, New York. $10.00.

Anales Universidad Central del Ecuador; Tomo LX, No. 304, Abril–Junio de 1938. Pp. 477 + 1178. Illustrated. Universidad Central, Quito. S/. 5,00.

BENT, ARTHUR C. *Orders Falconiformes and Strigiformes.* Pp. viii + 482. 92 plates. U. S. National Museum Bulletin 170, Smithsonian Institution. Superintendent of Documents, Washington. $0.60.

Calcutta School of Tropical Medicine and the Carmichael Hospital for Tropical Diseases, Annual Report, 1937. Pp. 181. Superintendent, Government Printing, Alipore, Bengal. Gratis.

JACOBSON, EDMUND. *You Can Sleep Well; The A. B. C.'s of Restful Sleep for the Average Person.* Pp. xix + 269. Illustrated. Whittlesey House, McGraw-Hill. $2.00.

LAUFER, BERTHOLD. *The American Plant Migration; Part 1, The Potato.* Pp. x + 132. 6 figures. Field Museum of Natural History. $1.50.

MARTIN, PAUL S. *Archaeological Work in the Ackmen-Lowry Area, Southwestern Colorado, 1937.* Pp. 219–304. Illustrated. Field Museum of Natural History. $1.75.

SCOTT, J. F. *The Mathematical Work of John Wallis, D.D., F.R.S. (1616–1703.)* Pp. xi + 240. 12 figures. Taylor and Francis, London. 12s 6d.

SMITH, A. D. BUCHANAN, O. J. ROBINSON and D. M. BRYANT. *The Genetics of the Pig.* Reprinted from Bibliographia Genetica XII. Pp. 160. 21 figures. Martinus Nijhoff, The Hague, Holland. Gld. 8.-

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STANDLEY, PAUL C. *Flora of Costa Rica.* Pp. 783–1133. Field Museum of Natural History. $2.50.

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[3] Svedberg, *Ind. and Eng. Chem.*, 10: 113, 1938; *Nature*, 139, 1051, 1937.

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ANIMAL EXPERIMENTATION IN BIOLOGY AND MEDICINE[1]

By Professor A. J. CARLSON

UNIVERSITY OF CHICAGO

THE contributions of experiments on animals to present-day biological and medical knowledge and medical practice is so conspicuous and well known to our profession that my discussion would be out of place in this gathering except for the fact that in a democracy like ours the science and the service of biology and medicine must rest on the broad base of general approval of society and can not be many leagues ahead of the understanding of the average layman. The fact is that there is in our nation still a small body of apparently sane men and women, so poorly informed that they deny the value of animal experimentation for human health and human understanding, men and women so misled that they would, if they could, stop by law the humane use of animals by us in our perpetual labor towards understanding and controlling life and death processes. This is a stern reminder that we should forget that part of the oath of Hippocrates enjoining us to secrecy, that we must ever pass on what we have discovered to all our fellow citizens. This teaching must be done with patience, in true humility and without rancor, as the people in the mart and on the ranch have not traveled our path, hence can not possibly see eye to eye with us, without fair discussion. We, who have had the privilege to delve deepest into the nature of life and the control of disease, would be poor soldiers indeed, did we not strive to shield our fellow men from the consequences of their honest but misguided emotions.

The misguided opponents of modern medical research and modern medical practice charge that animal experimentation *is futile, is without benefit to man.* They charge that animal experimentation in biological and medical teaching and research is cruel. Fellow citizens, these are serious charges. What are the facts? To-day man's achievements in medicine and biology are very significant and most cheering to all mankind. Many causes have contributed to this happy progress in understanding of the workings of the human and animal body, and the gradual conquest of human and animal disease. The new discoveries in the basic sciences of chemistry and physics have given the biological and medical investigator new methods of solving old problems, such as kidney disease and *the toxemias of pregnancy, new tools for penetrating* further and further into the mysteries or the unknowns of life both in health and disease. But without freedom in research; without the confidence in and the moral and financial support of medical and biological investigation by governments, and by individuals our achievements in the understanding of man and the conquest of disease would have been scant, indeed, despite the significant discoveries, the new ideas, the new tools furnished us by our illustrious brethren in chemistry and physics. This is almost self-evident. Modern medical research costs much money, and the investigators must have freedom to work, to experiment, to *try again and yet again, under guidance of the moral* code of civilization, but unhampered by special philosophies, special superstitions or special prejudice. The moral code of civilized man, as I understand it, reads thus: As between men and the animals, man comes first. This is the law of life. But when man uses or destroys the animal for man's own protection, aid or other interests, such use or destruction must be done without cruelty. I regard kindness to all animals as one of the finest and fairest fruits of human development, especially when the emotion of kindness is tempered and directed by a profound understanding of the complexity, beauty and unity of all life, man, animal and plant.

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[1] Address in the Symposium on Animal Experimentation, Pacific Division of the American Association for the Advancement of Science, San Diego, Calif., June, 1938.

All science is one, at least in the principle of the scientific method. Physics, chemistry, the technical arts have made the marvelous advances by working with, by experimenting with all forms of matter and energy known to man in the universe, by putting new questions to old "Mother Nature" and seeking newer and better answers by newer and better experiments by means of newer and better tools. If the mineral pitchblende had been taboo to the chemists, the discovery of radium and the subsequent explosive evolution in chemistry and physics could not have taken place as one of the great advances in our knowledge of the world during the present century. In the same way the biological and medical investigator endeavors to use newer and better tools in clearing up the many unknowns in living matter in health and disease, trying newer and better experiments on all forms of life—plant, animal, man.

First, there is an essential unity of all life. Informed laymen are well aware that animals are built on the same plan as man; they have the same organs working by the same nervous and chemical machinery. The animals subsist essentially on the same kind of food and the same kind of air as man, and are subjected to essentially the same kind of disorders as man. The causes and effects of disorders of the heart, the stomach, the lungs, the eyes, the nerves or the brain are essentially the same in animals and man. When the experimental method was introduced in science, including the science of medicine, experiments on animals resulted in rapid progress of our understanding of the nervous and chemical machinery operating in the body in health and disturbances of this machinery that leads to disease. Thus, animal experimentation has played a very great role in the development of our knowledge of infections and their control, of anesthesias and their refinement, of disturbances in nutrition and dietary deficiencies, in growth, in the development of new and valuable drugs and their continued refinement.

One of the great discoveries in medicine of all times is the approximate causes of pernicious anemia and the control of pernicious anemia by the liver and gastric principles. I glory in the fact that this discovery was made in this country, our country, these United States. The first steps were taken by experiments on dogs in the city of San Francisco in the great University of the State of California. Then the ball passed to the Atlantic coast, to fair Harvard. And now the whole world cheers California and Harvard, and Dr. Whipple, and Dr. Minot, and Dr. Murphy. Citizens of California, remember that cheer when you are confronted with proposals to shackle your great universities, proposals which say in effect, that good doctors of this state can not be trusted to treat unclaimed stray dogs humanely!

There were more than thirty years of intensive research on animals—mainly on the dog—before we had the substance insulin in sufficient purity to warrant its trial on people sick with diabetes; and even now every new lot of insulin must be tested on animals before it is safe for the sick man, the sick woman or the sick child. Every informed layman now knows the value of insulin in diabetes in man. You need not take my word for it. Read history and form your own judgment. These facts are obvious. I sincerely believe that if every man and woman in this country knew the inspiring story of the discovery of insulin, all voices would be raised in approbation of such fruitful animal experimentation.

Second: Free and intelligent experiments on animals during the last three hundred years have been the greatest factor in our present achievements in knowledge of the nature of life and control of disease. It was not till the great William Harvey began to observe and experiment on animals that we started to understand the heart, the blood, the circulation. We began to make real progress in the understanding, if not in the control of cancer, when this malady was discovered in animals and experimentally produced in animals. The lowly mouse, not to mention many other species, has served man well in research on cancer. But we can not say to-day what animal will yield the hoped-for answer to cancer prevention or cure. Animal experimentation has been a great factor also in giving us better knowledge of nutritional anemia, digestive and kidney disorder, glandular disturbances, nervous diseases, the control of tuberculosis, scurvy, hookworm and pellagra.

I wish that all citizens would read the history of biology and medicine of the last three hundred years, and really be informed as to the facts and value of animal experimentation as it is carried on at Berkeley, at Stanford, at Los Angeles, at Harvard, at Yale, at Johns Hopkins, at Chicago, at the Rockefeller Institute and at the Mayo Clinic, in fact, at any first-class university, medical school or hospital here or abroad! Would the commonwealth care to live under the health conditions and be treated for sickness by the empirical and often harmful methods that obtained before animal experimentation laid down the laws for personal and public health and hygiene, which minimized the incidence of epidemics, made the physician a real diagnostician, surgeon and healer? Would the commonwealth care to be deprived for one day of the fruits of animal experimentations in the realm of health and disease of man as well as animals?

I could speak to you for hours on what experiments on animals in veterinary medicine have done for the health and happiness of the dog and the cat, the horse, the heifer, the hog and the lowly hen. We can rid the dog of harmful parasites, including the hookworm, and we are well on the road to prevent dog distemper. As to rabies, we are still in the trenches but making progress. But let the record speak for itself.

Third: Experimentation on animals is essential for the practical application of a great deal of present medical knowledge in the prevention or cure of disease. Animals produce antitoxins for us; they are essential in the discovery and standardizing of new remedies. They are necessary for the diagnosis of some forms of tuberculosis. They are of great service in some aspects of human pregnancy. The modern story of foods, nutrition and the known disorders of nutrition would be largely gaps and guesses, except for the services of the rat, the pigeon and the dog. In brief, we would be greatly hampered in applying the known facts to society were society to stop the doctor and the biologist from the humane use of animals in the scientific service of man. It would have been far better had we used some dozen dogs and guinea pigs in testing the tragic Massengill sulfanilamid elixir. If we had, the killing of nearly a hundred citizens would not now disfigure the fair escutcheon of our country.

Fourth: Animal experimentation seems essential for further progress in biology and medicine. Experimentation has certainly proved its value in the biology and medicine of yesterday and of to-day. But what about to-morrow? Do we know it all now? Or, if not, can't we find the missing answers by intuition, inspiration or logic? I see no hope in that direction. These methods failed in the past. I see no greater value for them in the future. After more than a third of a century's service in biology, it seems clear to me that intelligent and humane use of all species of animals will be necessary on the road to a fuller understanding and control of heredity, growth, cancer, immunity, colds, pneumonia, nervous, glandular, nutritional and mental disorders.

Furthermore, the use of animals is of continuous and increasing importance in the training of the doctor and the biologist of the future. Unfortunately, parents do not transmit their individually acquired knowledge and skill to their children. Each generation must learn for itself, mainly by the old slow and painful method of trial and error. If the society of to-morrow needs the services of doctors and biologists, common sense seems to say that their training is a matter of importance, a training in nature as well as in books. That means, we need animals in the training of doctors and biologists, and animals can be so used, and are so used, without cruelty.*

Fifth: Animal experimentation is humane. As to the charge of uselessness and futility of animal experimentation, the answer is given by the history of medicine and biology. As to the charge of cruelty, I have a word to say as a man who has been engaged in animal experimentation for over a third of a century and should know something about it. Cruelty is the wanton or useless infliction of suffering on man or animals. I know the biological and medical research laboratories in this country and abroad, and can state as a fact that in animal experiments involving pain the same anesthetics are used as in surgical operations on man. Neither man nor the animal needs an anesthetic to stand a mosquito bite or the passing of the hypodermic needle through the skin. Moreover, an animal in distress usually can not answer the questions put to him by the medical investigator. When animals under anesthesia are used in medical teaching, they are not allowed to come out of the anesthesia. Death by anesthesia is probably one of the least uncomfortable deaths. There is inflicted on animals more pain in one hunting, trapping and fishing season than in all the centuries of animal experimentation. The pain inflicted by the hunter, fisherman and trapper is not wanton, to be sure, and yet inevitable.

We use animals, by common consent, for food, for clothing, for labor, for pleasure. How can it be wrong to use animals humanely to increase our understanding of life, our control of disease, both of which contribute to human happiness? We must retain a sense of proportion. Man survives only by destruction of plant and animal life for his food. Man's welfare demands either death control or birth control of the animals, but these must be carried out humanely. When the animal dies as a part of biological and medical investigation, the death is humane. We can not indict or convict of cruelty to animals our universities, medical schools and hospitals on any evidence so far brought forth by the adversaries of modern medicine. And believe me, I have heard it all.

Biological and medical investigation and teaching, guided by the humane behavior of the sane and civilized man, must remain free, must not be restricted, lest we condemn our children to dreary decades of medical stagnation.

Whenever I hear this charge of cruelty to dogs and other animals in biological and medical laboratories, it is difficult for me to follow the precepts of the Bible, and "suffer fools gladly." The attitude and practice of kindness is one of the fairest flowers of human evolution, and we must cherish it. But let us not put the flower of kindness to the dog into the ugly bouquet of unfairness, cruelty, injustice and deception to man. Let us not peddle falsehoods against our fellow men who obey the higher moral imperative of endeavoring to make the world to-morrow a little better than it is to-day. In that group marches the doctor, the biologist, the medical investigator, even though at times our steps falter. At birth, at death and in between at times of pain and strain the doctor is near to guide and succor. Is this doctor, and his teachers in our great medical schools, to be smeared with the charge of cruelty to stray dogs by the enactment of special legislation? In practical life, animals, as well as plants, must be adjusted primarily in the interest of man. We do so necessarily in the case of bacteria, flies, rats, insects and all manner of wild and domestic animals. In my philosophy, man comes first. I will gladly contribute to shelter for stray or uncared-for dogs, when my fellow human beings, and particularly children, are adequately cared for. I am unable to account for the repeated charge of cruelty in animal experimentation and cruelty in the experimenter by apparently sane people who do not take the trouble to visit the university laboratories and the hospitals where such experiments are going on, or to investigate the reputation for cruelty or kindness of the individual investigator in the community. I am not aware that the part of the decalogue reading, "Thou shalt not bear false witness against thy neighbor," has been repealed. I think it should still guide the tongue and pen of honest men. Some of the finest men and women that it has been my privilege to meet in my long life have been investigators in biology and medicine, particularly by the methods of animal experimentation. Such well-known humane citizens as Jane Addams, Dean Gilkey, Clarence Darrow, Archbishop Dougherty, Archbishop Curley, Bishop Lawrence and Rabbi Mann have for years upheld and defended the necessity and utility of animal experimentation in medical research and medical teaching.

Sixth: The tactics of the adversaries to modern biology and medicine. The group that endeavors to cripple the progress of modern biology and medicine by propaganda and restrictive legislation is made up of a small core of peculiar people; the blindest of the blind; people who do not want to see. This small group, through a persistent propaganda of mainly false charges, misled a much larger number of poorly informed but otherwise fine, sane, kind and excellent citizens. The latter usually change their allegiance when they learn the truth about animal experimentation.

The smaller core would stop all animal experimentation if they could. When that attempt fails, they do not hesitate to "bore from within" the larger groups of humane citizens in the promotion of such hampering measures as unclaimed stray dogs not being made available for medical research and medical teaching in our schools. With this smaller fanatical core, these folks of peculiar faiths and philosophies, the end (crippling of modern medicine) justifies the means (a propaganda by falsehood). I have no quarrel with anybody's faiths or philosophies, as long as they are content to use it for their own individual guidance, and do not try to impose it by law on their neighbors. But when it comes to rank falsehoods, such that hurt society, I will not be silent. I will call a spade a spade, no matter who feels hurt. If we did otherwise we would be false to our higher obligation to man: To apply the known, to investigate the unknown, to give that service to society for which our abilities and special experience render us able. The liberal writer, Howard Vincent O'Brien, said recently:

> Life is an endless battle between sense and sentiment. Reason is forever at war with emotion. In a time like

this conditions are especially favorable for the growth of illusion. It is a time when wishful thinking has its chance to dissolve hard facts in a spray of emotion.

Outstanding among those who believe they can snivel their way to sense are the anti-vivisectionists. They will burble ecstatically about their beloved dogs; and wear furs, eat meat and swat the fly. When they are ill they will run for the doctor, but when they are well they do all they can to hamper the doctor in learning how to cure the maladies that afflict them.

If the anti-vivisectionists were content to preach their sentiment, sense would have little to fear from them. Unfortunately for sense, this form of sentiment commands large resources in money and is able to exert pressure on public opinion. People of wealth, whose thinking is dominated by their emotions, are constantly bequeathing large sums to what they consider the worthy cause of stray dogs. It is confidently expected that a certain movie star will do that when he dies. Not knowing either his interest or his intention, millions of people go every day to see his pictures and unwittingly pay tribute to the cause of holding back progress.

In saying that, I expose myself to a deluge of protest from people who do not believe that experiment on living animals has produced any progress. I can only hope that such persons never have to see a child trying to breathe through a diphtheritic throat.

The cry of cruelty to animals does not fire me. For one thing, the pioneers of science take cruel and unusual liberties with their own persons. For another, the cruelty of man to his own kind exceeds anything perpetrated on the lower orders. Those who raise their cry of cruelty to animals seem to center their pathos on the dog. They are silent about the sufferings of the cat, the monkey, the guinea pig and the mouse; and, while they respond quickly to individual instances of human distress, they are fatalistic to the social injustice which causes them. It seems to me that first things should come first and that attacks on cruelty should begin with the sort which keeps humans cold, hungry and idle, and which sacrifices them in the senseless hecatomb of war.

I have no scorn for minorities or for those who see visions. On the contrary, I believe that there is more in heaven and earth than is yet dreamed of in our philosophies. But I believe that truth is more likely to be reached on the hard paths and narrow bridges of experimental science than by the wings of revelation.

The late Clarence Darrow, a friend and champion of the "underdog," species *homo*, wrote me in 1934:

> When I was younger I was interested in anti-vivisection but have had no connection with it for a good many years. I have been pretty well convinced that the operation is now performed with care as to anesthetics which really takes away the horror of its contemplation. Then, too, at the very best the death of most animals is a horrible one, if death comes from natural causes. So I am satisfied that vivisection does not add to the pain of animal life. Then, too, I can see no difference between that and killing and eating meat, from which I abstained for a number of years. If the other animals were cared for as humans they would soon drive us off the earth. While I do not place the value of a man far above that of any other animal, still we have a better brain and we will not let the other animals destroy us. Long ago I made up my mind that with strict adherence to anesthetics the terrors and pain of animals is rather diminished than increased by vivisection. So, long ago I stopped advocating it.

In conclusion, may I say a word specifically to the citizens of the State of California? I feel I owe that to you, and I think I can do so without prejudice, for I am a kind of "native son" by adoption: I had the privilege of spending four profitable years in one of your great universities. I do not want to see my Alma Mater shackled. Section 10 of your proposed State Humane Pound Law reads as follows:

> It is unlawful for any poundmaster or assistant to use or permit to be used any live animal in his custody for experimental or commercial purposes or to turn over with or without remuneration, directly or by any indirect ways or means any dog, cat or other animal in his custody or over which he has or will have control to any person, school, university, research laboratory or experimental station to be used for educational demonstration, medical, scientific, and/or experimental purposes of any nature, or to any person, school, university, research laboratory or experimental station using animals for educational demonstration, medical, scientific or experimental purposes of any nature.

A vote for this measure is a vote of censure of your universities and medical schools. It is a vote to cripple, hamper and impose an impossible financial burden on medical education and medical research in California. It is a vote of lack of confidence in the medical profession of this state. A vote for this measure says: The leaders in medical education and medical research in the State of California can not be trusted to treat unclaimed stray dogs and cats humanely.

I am a democrat (spelled with a small "d") and believe in the democratic way of life. But the privilege and duty of the voting citizens entails the sober obligation to investigate before we vote. The story of modern biology and medicine, the work in our universities, in our medical laboratories of teaching and research are open books for every citizen to read. Do not take my word on faith, nor the word of our adversaries. Look up the facts for yourself.

This is what happened in my own city and state a few years ago, when opponents of modern medicine tried to shackle medical research and medical teaching. We invited our fellow citizens (including our adversaries) to come to our medical laboratories to see for themselves whether our work was futile and cruel. They came: legislators, aldermen, men of the mart and women of the home and club, men in the store and men in the street. They saw for themselves and then voted overwhelmingly to give unclaimed stray dogs to reputable laboratories for medical teaching and research, for humane service towards human welfare. This was done by the citizens of Chicago and the State of Illinois. Will the citizens of California do less? In your veins surges the blood of hard-headed pioneers, not yet greatly diluted by the passage of years. I know your magnificent mountains, your fertile valleys, your unique forests, your charming shores. Your institutions of higher learning, of medical education and medical research have flourished like the bay tree. Yours is a happy acre. But has this garden of Eden made you soft in brain and spine? It would be a strange spectacle to see the state of the "forty-niners" as the spear-head of the misguided communities who put the alleged happiness of unclaimed stray dogs and cats above the progressive welfare of our own species; misguided communities, who would rivet restraining shackles on the noblest endeavors of man.

OBITUARY

NATHANIEL GIST GEE

IN the quiet of his home at Greenwood, South Carolina, on December 18 last the long career of usefulness of Nathaniel Gist Gee came to its close. He was born in Union, S. C., on April 20, 1876. He was educated first in the public schools of Union and then in Wofford College, where he graduated in 1896. He was principal of Jordan (S. C.) Academy, 1896–1898, professor of natural sciences in Columbia College, 1898–1901, and he attended at intervals summer sessions at Harvard, Chicago and Columbia Universities. Then he went to China for a long stay at Soochow University, first as professor of natural sciences and later as head of the department of biology, 1901–1915. During this period he trained many of the Chinese investigators of the present day for the studies of the local fauna that they have since carried on with distinction.

After an interval of a few years spent again in teaching in his native state, he returned to China. For a year he was Far-Eastern representative of the Spencer Lens Company. He then joined the China Medical Board of the Rockefeller Foundation as adviser on premedical education, and was assistant resident director in 1926–1928 and adviser for China in 1928–1932. Then he returned to America and was professor of biology at Landon College at the time of his death.

In the Peking Society of Natural History he was successively charter member, organizing secretary, life member and president. He was a member of the Board of Managers of the Fan Memorial Biological Institute. For two years he was president of the East China Educational Association. He was a fellow of the American Association for the Advancement of Science and a corresponding fellow of the American Ornithologists Union.

He was joint author of lists and manuals of the birds of China and interested himself in the fauna and flora of that country generally, but his specialty was fresh-water sponges. He published extensively and became a well-known authority on that group, and amassed a very fine collection from world-wide sources.

He was a good naturalist, a good teacher, an ever helpful, kindly and generous friend of youth and a promoter of good will toward all mankind.

JAMES G. NEEDHAM

RECENT DEATHS AND MEMORIALS

DR. FREDERICK H. FLAHERTY, professor of clinical surgery at Syracuse University, died on September 7, at the age of sixty-five years.

DR. DERRICK NORMAN LEHMER, professor emeritus of mathematics at the University of California, died on September 8 at the age of seventy-one years.

RAYMOND H. TORREY, of Hollis, Long Island, botanist and conservationist, died on July 15 at the age of fifty-eight years.

THE yearbook for 1938 of the U. S. Department of Agriculture, entitled "Soils and Men," the third in the new series dealing with special subjects, is dedicated to the memory of Curtis Fletcher Marbut, for many years chief of the Soil Survey Division. The tribute to Dr. Marbut says in part: "Under his guidance, work in soils became a recognized science in the United States. His own researches in soil classification and geography laid the foundation for our modern concepts of soil."

SCIENTIFIC EVENTS

FORESTS OF THE PACIFIC NORTHWEST

THE Pacific Northwest Regional Planning Commission, in a report published by the National Resources Committee, urges immediate and general adoption of sustained-yield management to conserve the forests of the Pacific Northwest, pointing out that the timber supply is being dangerously depleted. The report lays stress on the importance of sustained-yield management as advocated by the U. S. Forest Service.

It is pointed out that half the remaining timber supply and forty per cent. of the water power resources of the United States are situated in this region and that the situation with respect to this forest resource is critical, that the threat of loss of a resource of incalculable value is a serious one, and that solution of the problem will become increasingly difficult unless substantial progress in conservation, including protection and improved management, is made. So far as merchantable major timber and the timber industry are concerned substantial depletion may come about in a relatively short time unless remedial steps are taken.

The proposed legislative and administrative program of the commission for placing forest land under sustained-yield management include:

(1) Provision for putting all publicly owned land on a sustained-yield basis.

(2) Provision for the organization and operation of cooperative sustained-yield units which include both public and private land under contracts providing adequate protection of public interests involved.

(3) Provision for long-term public credits at low interest rates, for timber operators working on a sustained-yield basis.

(4) An increase of public fire protection appropriations sufficient to insure adequate fire protection.

(5) An authorization and appropriation of sufficient public funds adequately to combat, in cooperation with private owners, the ravages of timber-destroying insects and diseases.

(6) Authorization and provision of funds for public acquisition of both timbered and cut-over private lands where such acquisition is necessary for effective sustained-yield forest practice.

(7) A change in the taxation system so as to relieve timber properties from pressure for immediate liquidation and at the same time provide funds for the adequate conduct of local tax-supported units.

(8) Increased public appropriations for research in determining more effective methods of forest management and more complete utilization of wood and wood waste.

(9) Classification and zoning of land suitable chiefly for forest uses.

(10) Provide all practicable safeguards in public legislation, policy and administration to bring about full use of public contributions in the promotion of sound forest practices, including sustained-yield management.

THE UNIVERSITY OF CHICAGO COMMITTEE ON CANCER

THE appointment of a Committee on Cancer to correlate research on cancer and its clinical treatment has been announced by the University of Chicago. The committee will act virtually as a cancer institute. The university has received the sum of $11,750 in grants and gifts for work on cancer. Three grants, amounting to $7,500, were from the National Advisory Cancer Council of Washington to facilitate research on the influence of cancer on stomach secretions, on hormones and on chemical substances in cancer tissues. The International Cancer Research Foundation made a grant of $2,000, and the Educational Association on Cancer, of which Mrs. Frederick A. Lorenz, of Chicago, is president, gave $2,250 to establish a lectureship. This association is composed of Chicago women, who, for a number of years, have facilitated the spread of correct information on cancer. They sponsored a cancer exhibit at the 1933 World's Fair.

The committee will correlate all basic research with the efforts of the clinical departments. It will serve as a clearing house for investigators in nine departments and will advise the administration as to needs and policies of the general program, which now involves cooperative work in four clinical departments, medicine, surgery, obstetrics and gynecology, and roentgenology; and in five non-clinical departments, physics, chemistry, biochemistry, botany and pathology. The committee will act as a centralizing agency for cancer study in all these departments and perhaps extend the work into other departments.

Members of the committee, of which Dr. Alexander Brunschwig is chairman, include Dr. Fred L. Adair, chairman of the department of obstetrics and gynecology and chief of staff of the Chicago Lying-In Hospital; Dr. Percival Bailey, professor of surgery; Dr. Arthur H. Compton, Charles H. Swift distinguished service professor of physics; Dr. George F. Dick, chairman of the department of medicine; Dr. William D. Harkins, Andrew MacLeish distinguished service professor of chemistry; Dr. Paul C. Hodges, professor of roentgenology; Dr. T. R. Hogness, professor of chemistry; Dr. Fred C. Koch, chairman of the department of biochemistry; Dr. E. J. Kraus, chairman of the department of botany; Dr. D. B. Phemister, chairman of the department of surgery; Dr. Maud Slye, associate professor of pathology; Dr. Paul Steiner, assistant professor of pathology, secretary, and Dr. H. Gideon Wells, chairman of the department of pathology.

BRITISH RESEARCH FELLOWSHIPS

THE Medical Research Council of Great Britain has awarded Rockefeller traveling fellowships to the following for the academic year 1938–39:

Richard Raymond Bomford, B.M. (Oxon), M.R.C.P. (Lond.), assistant physician, London Hospital.

Thomas Colver, M.B. (Sheffield), M.R.C.P. (Lond.), out-patient medical registrar, Hospital for Sick Children, Great Ormond Street, London.

Robert Morton Heggie, B.Sc., M.B. (Glas.), assistant lecturer in pathology and bacteriology, The Welsh National School of Medicine, Cardiff.

Ian MacKenzie, M.B. (Edin.), F.R.C.S.E., assistant surgeon, St. Giles's Hospital, London.

George Geoffrey Evanson Smyth, M.D. (Manch.), M.R.C.P. (Lond.), Dickinson research scholar, National Hospital, Queen Square, London.

Ivor Glyn Williams, M.B. (Lond.), F.R.C.S. (Eng.), D.M.R.E. (Cantab.), senior assistant radiotherapist, Meyerstein Institute of Radiotherapy, Middlesex Hospital.

These fellows propose to work at centers in the United States, with the exception of Dr. Smyth, who intends to study in Paris.

In addition, the Rockefeller Foundation has awarded similar fellowships, on the recommendation of the Medical Research Council, to the following candidates in the special field of psychiatry, neurology and related subjects:

Thomas Russell Cumming Fraser, M.B. (New Zealand), M.R.C.P. (Lond.), assistant medical officer, Maudsley Hospital, London.

William Walters Sargant, M.B. (Cantab.), medical officer, Maudsley Hospital, London.

Michael John Francis McArdle, M.B. (Lond.), M.R.C.P. (Lond.), assistant medical officer, Maudsley Hospital, London.

The trustees have made the following awards for Beit fellowships for scientific research, tenable at the Imperial College of Science and Technology for the academic year 1938–39.

Extensions of fellowships already satisfactorily held for one year:

D. W. Goodall, B.Sc., A.R.C.S., for the continuation of his research on the physiology of the tomato plant, under the direction of Professor F. G. Gregory, D.Sc., D.I.C.

H. A. C. McKay, B.A., B.Sc., for the continuation of his investigation of chemical problems by the radioactive indicator method, under the direction of Professor H. V. A. Briscoe, D.Sc., A.R.C.S., D.I.C.

A. K. Powell, B.Sc., for the continuation of his research on parasitic wasps, in particular that of *Microbracon hebetor*, under the direction of Professor J. W. Munro, D.Sc., M.A.

New fellowships tenable for one year but renewable for a second:

J. L. O. G. Michiels, B.Sc., A.R.C.S., Royal College of Science, for research on the positions and widths of the energy levels of atomic nuclei by means of experiments on the capture of slow neutrons by various elements, under the direction of Professor G. P. Thomson, F.R.S.

E. J. Harris, B.Sc., Royal College of Science, for research on hydrocarbon oxidation and the reactions of peroxides with reference to carbon processes, under the direction of Professor A. C. G. Egerton, F.R.S.

THE INTERNATIONAL UNION OF GEODESY AND GEOPHYSICS

THE President of the United States has invited the International Union of Geodesy and Geophysics to hold its seventh general assembly in the United States in 1939. The invitations have been extended on behalf of the President by the Department of State through its diplomatic missions to the governments to which these missions are accredited, and invite the participating countries to be represented by delegates on this occasion.

It is planned to hold this seventh triennial assembly of the union in Washington, from September 4 to 15, 1939, according to a statement made by Dr. John A. Fleming, director of the Department of Terrestrial Magnetism of the Carnegie Institution, who is general secretary of the American Geophysical Union. The American Geophysical Union is the American Section of the International Union of Geodesy and Geophysics, and its executive committee is the Committee on Geophysics of the National Research Council. The council is collaborating with the American Geophysical Union as host to the assembly. The last general assembly of the International Union was held at Edinburgh, Scotland, in September, 1936.

The thirty-five nations at present adhering to the International Union are: Argentina, Belgium, Brazil, Bulgaria, Canada, Colombia, Chile, Czechoslovakia, Denmark, Egypt, Finland, France, Germany, Great Britain, Greece, Holland, Hungary, Indo-China, Italy, Japan, Morocco, Mexico, New Zealand, Norway, Peru, Poland, Portugal, Rumania, Siam, Spain, Sweden, Switzerland, Union of Soviet Socialist Republics, United States and Yugoslavia.

HARLAN T. STETSON

THE AMERICAN PUBLIC HEALTH ASSOCIATION

THE sixty-seventh annual meeting of the American Public Health Association will be held in Kansas City, Mo., from October 25 to 28.

It is announced that emphasis will be placed on the five major diseases which are being investigated with government funds. The problem of maternal and infant mortality will receive its share of attention. A special session will be devoted to a discussion of the "Public Health Aspects of Medical Care" with exponents of the National Health Program, spokesmen for organized medicine and representatives of the newly recognized medical consumers taking part. The recruiting and training of public-health personnel for specialized tasks for which trained workers are seriously lacking and the health department as a business organization will be discussed.

It is expected that more than four hundred papers and reports will be presented. Delegates will be present from every state in the Union, from Canada, Cuba and Mexico and from every branch of public health practice. There will be ten sections—Health Officers, Laboratory, Vital Statistics, Public Health Engineering, Industrial Hygiene, Food and Nutrition, Child Hygiene, Public Health Education, Public

Health Nursing and Epidemiology. In addition there will be joint meetings of two or more sections, and symposia have been arranged on the Phosphatase Test in the Control of Milk Pasteurization; Use of Biological Products; Water and Sewage; Frozen Desserts; Typhoid Fever; Pertussis; Nutritional Problems and Industrial Hygiene.

The following organizations are meeting with the association: the American School Health Association, the Conference of State Laboratory Directors, the Conference of State Sanitary Engineers, the International Society of Medical Health Officers, the American Association of State Registration Executives and the Association of Women in Public Health.

A Health Exhibit is being arranged of products, apparatus, equipment and services which have utility in modern public health practice and value in health protection and promotion.

THE AMERICAN MALACOLOGICAL UNION

THE American Malacological Union held its eighth annual convention in Havana, Cuba, from August 1 to 6, at the invitation of Dr. Carlos de la Torre, president of the union and professor emeritus of zoology of the University of Havana. On this occasion the Cuban Government provided free transportation on the Cuban cruiser *Cuba*, from Key West, Florida, to Havana and return, as well as hotel accommodations for the guests during their stay in Havana.

The meetings were held in the Academy of Sciences of the University of Havana, many valuable papers on malacology being presented. Dr. Paul S. Galtsoff, of the U. S. Bureau of Fisheries, in his paper on "Physiology of Reproduction in *Ostraea virginica*," recommended that Cubans take advantage of the natural marine conditions existing around Cuba for the cultivation of oysters and thus add a new industry to the country. Fred Orsinger, head of the U. S. National Aquarium in Washington, D. C., spoke in favor of a Marine Aquarium and Biological Laboratory for Havana, saying that such an aquarium could be maintained near Havana at a very low cost as compared with that of similar institutions in other countries.

Officers were elected as follows: *President*, Maxwell Smith, Lantana, Fla.; *Vice-president*, Dr. Horace B. Baker, University of Pennsylvania; *Corresponding Secretary*, Norman W. Lermond, Knox Academy of Arts and Sciences, Thomaston, Me.; *Financial Secretary*, Imogene C. Robertson, Buffalo Museum of Science; *Councillors at Large*, Dr. Henry van der Schalie, University of Michigan, and Dr. Myra Keen, Stanford University. *Past Presidents*, Dr. Joshua L. Baily, Jr., San Diego; Dr. Paul Bartsch, Smithsonian Institution; William J. Clench, Museum of Comparative Zoology, Harvard University; Calvin Goodrich, University of Michigan; Dr. Henry A. Pilsbry, Academy of Natural Sciences, Philadelphia, and Dr. Carlos de la Torre, University of Havana. *Honorary President*, Ida S. Oldroyd, Stanford University.

The meeting in 1939 will be held in the Royal Ontario Museum of Zoology, Toronto.

SCIENTIFIC NOTES AND NEWS

DR. A. T. HENRICI, professor of bacteriology and immunology at the University of Minnesota, was elected president of the Society of American Bacteriologists at the San Francisco meeting. Dr. I. L. Baldwin, professor of agricultural bacteriology at the University of Wisconsin and assistant dean of the College of Agriculture, was named secretary-treasurer.

AT the meeting of the International Committee of Historical Sciences, held in Zurich on August 28, in connection with the eighth International Congress of Historical Sciences, Dr. Waldo G. Leland, of Washington, D. C., executive director of the American Council of Learned Societies, was elected president for the term of five years, 1938–1943, succeeding Major Harold W. V. Temperley, university professor of modern history and master of Peterhouse, Cambridge.

DR. MARSTON TAYLOR BOGERT, professor of organic chemistry at Columbia University, was presented with the Priestley Gold Medal at the recent meeting in Milwaukee of the American Chemical Society. The thousand dollar prize awarded for "notable research in the important borderline field between organic and physical chemistry" was presented to Dr. Paul D. Bartlett, assistant professor of chemistry at Harvard University.

EARL OWEN SHREVE, vice-president of the General Electric Company, a graduate of the Iowa State College of the class of 1904, is the first recipient of the Marston Medal. This award, established by Anson Marston, dean emeritus of engineering, "is granted, not oftener than once a year, in recognition of outstanding achievements of an alumnus in the field of engineering."

THE ersatz prizes, which take the place in Germany of the Nobel prizes that Germans are forbidden to accept, have been awarded to Professor Ferdinand Porsche, designer of the "Volkswagen"; to Dr. Fritz Todt, general inspector in charge of the superhighway construction program, and to Ernst Heinkel and Willy Messerschmidt, airplane designers and constructors, who halved one prize of 100,000 marks. The presentation of prizes preceded Hitler's annual address at a cultural session of the Nazi party.

The Prussian Academy of Sciences has awarded the gold Leibnitz Medal to Dr. Hans Herensky, of Johannisberg, and the silver Leibnitz Medal to Dr. Georg von Békéssy, lecturer on acoustics at Budapest.

Dr. Wilhelm A. P. Schüffner, director of the Department of Tropical Hygiene at the Royal Colonial Institute of Amsterdam, has been awarded the Gold Medal of Honor by the Hanseatic University of Hamburg.

Dr. William J. McNally, otolaryngologist to the Royal Victoria Hospital, Montreal, was recently awarded the Dalby Prize of 100 guineas of the Royal Society of Medicine of England "for the best work in otology published or done during the previous five years."

Professor Gerard De Geer, glacial geologist of Sweden, will observe his eightieth birthday on October 1. Dr. Richard J. Lougee, of the department of geology of Colby College, has arranged a field meeting and program on October 1 and 2 at Dartmouth College, where De Geer's methods of measuring the rate of glacial recession have been employed. Professor J. Walter Goldthwait will act as chairman and has offered the facilities of the department of geology of Dartmouth College for the celebration. As a special feature of the meeting the technique of measuring clay sections will be demonstrated in the field, and graphs will be constructed in order to illustrate De Geer's method of matching varves. For this demonstration there have been selected two varved clay exposures two miles apart on opposite sides of the Connecticut River.

The Michigan College of Mining and Technology has conferred the doctorate of science on Dr. Charles M. Carson, for the past twenty-five years head of the department of chemistry and for ten years head of the department of chemical engineering, and the doctorate of engineering on William Wraith, mining engineer, alumnus of the college in the class of 1894.

Dr. Isaac McKinney Lewis, professor of botany and bacteriology at the University of Texas, has received the award of the Board of Regents for 1938 to 1939, which relieves him of some teaching in order to permit time for research. At the end of the year the recipient of the award is expected to give a series of public lectures giving the result of his work.

Dr. Edward L. Rice, head of the department of zoology at the Ohio Wesleyan University, with which he has been connected for forty years, has been appointed by the board of trustees acting president of the university until a successor is chosen to take the place of President Edmund D. Soper, whose resignation became effective on August 31.

Dr. Harold E. Burtt, professor of psychology at the Ohio State University, has been appointed acting chairman of the department. The department has been administered by a faculty committee during the past year, with Dr. Burtt as its chairman.

Dr. D. Eldon Beck, head of the biological sciences at Dixie Junior College, St. George, Utah, has been appointed assistant professor of zoology and entomology at Brigham Young University.

At the School of Chemistry of the University of Virginia Dr. James Webb Cole has been promoted from instructor to assistant professor; Dr. Alfred Burger, formerly research associate, has been appointed acting assistant professor, and Dr. Robert Hill Kean has been appointed instructor.

Phil C. Orr, assistant in paleontology in the department of geology of the Field Museum of Natural History, Chicago, has resigned in order to accept a position as curator of archeology and paleontology at the Santa Barbara Museum of Natural History. Paul McGrew has been appointed assistant in the division of paleontology at the Field museum. Mr. McGrew, who has specialized in paleontology as a student at the University of Chicago, will work on the preparation of prehistoric animal specimens and will conduct research in this field.

The Institute of Medicine of Chicago has awarded the Jessie Horton Koessler Fellowship for research in biochemistry, physiology, bacteriology or pathology for 1938–39 to Ralph E. Kirsch, who has completed three years of the medical course at the University of Chicago. His work on the control of length of gestation will be carried on under the direction of Dr. Allan T. Kenyon, of the Division of the Biological Sciences.

Dr. Rudolph Matas, emeritus professor of surgery in the School of Medicine of Tulane University, left New Orleans on September 3 for Brussels, where he will preside at the eleventh International Congress of Surgery, which will be held from September 19 to 22.

Dr. Isaiah Bowman, president of the Johns Hopkins University, who sailed in July as head of the American delegation to the International Geographic Congress, meeting at Amsterdam from July 18 to 28, returned to the United States on September 8.

John R. Millar, leader of the Sewell Avery Botanical Expedition to Nova Scotia of the Field Museum of Natural History, returned to Chicago on September 8. Mr. Millar has been exploring the shores of the Bay of Fundy, collecting the material and making photographs and color notes for guidance in the construction of a proposed exhibit of marine plant life. Sharat K. Roy, curator of geology and leader of the

Sewell Avery Physical Geology Expedition, who recently completed his work in northern Colorado, has left for the east to continue the collecting of rocks for purposes of exhibition and study.

DR. PHILIP MANSON-BAHR, director of the clinical division of the London School of Tropical Medicine, lectured during the first week of September before the San Francisco County Medical Society, the students and staff of the University of California Medical School and the Berkeley chapter of Delta Omega, the national public-health honor society.

DR. CARL J. WIGGERS, professor of physiology of the School of Medicine of Western Reserve University, left for the Argentine on September 9. He will give lectures before the sixth National Congress of Medicine at Cordoba; the Medical School, Cordoba; the Medical School, Rosario; the Medical School, the Argentine Society of Cardiology and the National Academy of Medicine, at Buenos Aires. He will return to Western Reserve University in November.

THE Genetics Society of America held its Woods Hole meeting on September 2 and 3 at the Marine Biological Laboratory. On Thursday evening preceding the meeting, Dr. H. J. Muller spoke on "The Remaking of Chromosomes." Both Friday and Saturday mornings were given over to demonstrations and exhibits in the Old Lecture Hall, followed by reading of short papers in the auditorium. On Friday afternoon and evening there were boating trips and a clam bake at Tarpaulin Cove, attended by over one hundred and fifty members of the society and other biologists.

THE meeting of the French Association for the Advancement of Science will be held from September 22 to 27 at Arachon.

THE twenty-seventh meeting of the Italian Society for the Advancement of Science was held at Bologna under the presidency of the rector of the university from September 4 to 11.

THE sixth general assembly of the International Scientific Radio Union took place at Venice and Rome from September 4 to 14, where plans were formulated for cooperative international research, including plans for radio experiments on a world-wide scale during the solar eclipse in 1940. The fiftieth anniversary of the discovery of electric waves by Heinrich Hertz was commemorated at the meeting.

THE sixth triennial congress of the International Society of Sugarcane Technologists will meet in New Orleans from October 24 to November 7. After establishing headquarters in New Orleans, members will tour during the first week the "sugar bowl" parishes of the state and during the second week will participate in a series of technical lectures and discussions at the Louisiana State University. Dr. C. W. Edgerton, head of the department of botany, bacteriology and plant pathology of the Louisiana State University, is general secretary-treasurer of the society and is in charge of preparations for the meeting. Dean J. G. Lee, Jr., of the College of Agriculture, is chairman of the local committee. Representatives of foreign divisions are expected from the Philippines, India, China, Java, South Africa, Formosa, Egypt, Australia, England, The Netherlands, British West Indies, Mexico, Colombia, Brazil, Argentina, Puerto Rico, Cuba, Hawaii and Pacific Islands.

AN assembly of laboratory directors and serologists to consider means and methods to improve and make more available serodiagnostic tests for syphilis, will be held at Hot Springs National Park, Ark., on October 21 and 22, under the auspices of the Committee on Evaluation of Serodiagnostic Tests for Syphilis, of which Surgeon-General Thomas Parran is chairman.

THE Paris correspondent of the *Journal* of the American Medical Association states that the opening session of the first Congress of French-Speaking Microbiologists, to be held from October 26 to 29, will be devoted to a celebration of the fiftieth anniversary of the Institut Pasteur of Paris. Addresses will be made by M. Lebrun, president of the French Republic, and M. Rucart, minister of public health. A number of papers will be presented on microbiologic subjects. The October 29 session will be devoted to a discussion of the ultra-virus. Information regarding the congress can be obtained by writing to the Association des microbiologists de langue française, Institut Pasteur, 28 rue du Docteur Roux, Paris 15.

Nature writes: The conference which opened at Evian on July 6 to discuss the plight of German and Austrian refugees was watched by a great body of opinion in Great Britain in which scientific workers are well represented. A letter welcoming the initiative of the Government of the United States in this matter, which was sent to President Roosevelt on May 31, bore the signatures of many eminent men of science among other leaders of intellectual life. The letter urged that cooperation should make it possible to facilitate the transfer of refugees to those countries where their abilities can find most scope, and to provide funds to enable them to make a fresh start, and urged the British Government to play its part both administratively and financially in the support of the great traditions of liberty, tolerance and humanity which it has in common with the United States. A further letter to the chairman of the conference urged the importance of immediate, constructive and practical decisions alike on religious, humane and economic grounds if the great democracies are to retain their ancient traditions of freedom and the right of asylum.

DISCUSSION

THE EVOLUTION OF PHYSICS

THE term evolution may connote different ideas to different people. To the man on the street it may conjure up a monkey; to the biologist it may mean the very gradual building-up of complex forms from primitive cells; to some physicists it may suggest the breaking-up of heavy, unstable, complex atoms into lighter simpler ones, the radioactive family tree. But it may mean the evolution or the growth of ideas in physics. Even here, however, the theorist may stress one view, the experimentalist another.

Let us compare a recent book, "The Evolution of Physics," written by theorists Einstein and Infeld (Mr. A) with a book having the same title which might be written by an experimental physicist (Mr. B). It will be seen that B might claim that A's title is a misnomer. Moreover, B would take vigorous exception to some of A's views. According to A (page 33), "Physical concepts are free creations of the human mind." B believes that physicists are slaves; they are under compulsion to form concepts in accord with experimental results. He gives one notable example. Planck, in order to account for the experimental data regarding black body radiation, found it necessary to make an unwanted, a seemingly absurd assumption; namely, that radiant energy is emitted and absorbed in bundles. Thus came into existence the quantum idea, the most important concept of the past forty years, the concept now of overwhelming importance.

Again, according to A (page 9), "Human thought creates an everchanging picture of the universe. Galileo's contribution was to destroy the intuitive view and to replace it by a new one." Here it seems to be implied that our picture of the universe may be formed merely by thinking about it. But we can hardly claim that a picture so formed would necessarily have any place in the evolution of physics. Our waste baskets have received many communications presenting pictures of the universe formed by thinkers. As to Galileo nowhere in A's book is it brought out that the great contribution made by Galileo was the idea of measurement, exact measurement, and of concepts depending upon experimental evidence. According to B this idea was the foundation stone of the solid structure of physics.

B would emphasize the fact that physics is an experimental science, that its evolution has been due to the exhaustless energy of experimenters. But A seems to regard experimentation without a pre-existing theory as rather useless. Consider, for example, the statement on page 73, "It is hardly possible to imagine such experiments (electrical) performed in accidental play without the *pre-existence* of more or less definite ideas regarding their meaning." What pre-existing theory did Roentgen have regarding x-rays, the existence of which were unsuspected? Did the Curies preconceive the astounding properties of radium or vision the universe that was to be opened up by its discovery? As a further evidence that A regards the growth of physics to be chiefly along theoretical, not along experimental lines, it may be noted that the name of Rutherford—the greatest experimental physicist since Faraday—occurs only once (page 272), and the great domains which his researches opened up are ignored.

B would point out that the greatest step of all time in the evolution of scientific thought was the contribution made by Newton, who, basing his argument upon the experimental work of Tycho Brahe, Kepler and Galileo, came to the conclusion that every particle of matter in the universe attracted every other particle. No longer was the motion of a heavenly body a mystery—it was identical in nature with that of a stone falling to the earth. To vision all the particles of the universe as attached to one another by bonds which could not be altered by the interposition of other particles was to *create* a new universe.

A devotes about half his book to a discussion of two topics, the field and the theory of relativity. To the man on the street the term field may mean a plot of land, perhaps enclosed by a fence. But A develops at length the Faraday-Maxwell picture of a field as a region in which forces exist, a region of energy due to masses or electric charges. This point of view was a very prominent one in the physics of the later decades of the nineteenth century. It was taught that the important feature of an electric current resided not in the wire but in the region outside of the wire, in the field due to the current. It was rude, rather indelicate, to ask what an electric current is, one should not attempt to form a picture of a current, one should emphasize the importance of the field. Then came the discovery of the electron, and an electric current became a procession of electrons. The mechanical view, the old electric fluid (atomized, modified) returned. The concept of the field remained, but it no longer excluded an inquiry into the nature of its origin.

B would give small space to the theory of relativity. He would point out that, so far, it has played but a small part in the great growth of physics. The one notable relation concerning the increase of mass with speed, which is frequently spoken of as the relativistic relation, was derived by Lorentz, as were also the transformation equations connecting time and space for moving axes. The equivalence of mass and energy can be derived at once from the Lorentz relations. All these relations are also outstanding results of the relativity theory and are thought by many to justify our attaching importance to that theory, but it is seen that they may be regarded as having another and earlier origin.

A devotes about one sixth of his book to modern physics, including the quantum theory—the outstanding theory of our time. B would give the major portion of his book to modern physics. The discovery of x-rays in 1895—what a burst of scientific activity followed! It is frequently stated that this discovery was accidental—but it was no accident that Roentgen was trying to find more facts connected with the discharge of electricity through a very rare gas. The discovery of x-rays led (1896) directly to that of the Becquerel rays from uranium; this again led (1898) directly to the discovery of radium. In the meantime (1897) the electron was discovered by J. J. Thomson, but its clear identity was not established without using the property of x-rays in ionizing a gas.

X-rays, the electron, radium—what a new world came into being! The atoms of chemical elements hitherto indivisible, indestructible units, definite for every element, had at least common constituents, electrons. But Rutherford and Soddy, working with radium, set forth the view that the radioactive, also the heaviest, atoms shot out either helium atoms or electrons and were thereby transformed into atoms of their chemical neighbors. Natural transmutation of the elements undreamed of before the present century, even by alchemists, came into our vision.

In the meantime, another line of experimental work had established certain laws regarding radiation from a hot source. To satisfy these laws Planck (1900) found it necessary in his theory to introduce the idea that radiant energy was tied up in bundles. The experimental physicist (B) would place great emphasis upon the quantum theory, for practically all phenomena are in accord with it. To change our point of view regarding radiant energy from being a phenomenon of continuity to one of discontinuity, from being one of wave motion to one of atomicity was to bring about one of the most important steps in the evolution of physical thought.

The chapter dealing with the evolution of our ideas regarding an atom would be a very long and important one in B's book. It would begin with the post-Dalton pre-electron atom, the perfectly elastic sphere (?), the atom which accounts for the properties of gases, it would continue with the post-electron pre-nuclear atom, the pumpkin atom, then with Rutherford's great contribution, the nuclear solar system atom, with the atom of definite energy levels initiated by Bohr. Here the evidence regarding energy levels becomes bewildering in its complexity, the evidence brought out by atomic spectra due to visible radiation, infra red, ultra violet, x-rays. If B would continue with the arrangement of atoms in molecules, as evidenced by molecular spectra, the Zeeman and Raman effects—this chapter might become a volume.

B would necessarily give space to the exceedingly accurate measurement of the mass of an atom, by Aston, Dempster and others, to the evidence that an element may have several different kinds of atoms, that besides the outer electrons the nucleus, minute in size, must contain protons (hydrogen nuclei) and neutrons and that the atoms of an element differ only in the number of the neutrons, the atoms of different elements only in the number of protons. That expulsion of a proton or a neutron may be brought about by atomic projectiles—that we may have artificial transmutation and radioactivity. No alchemist in his wildest moments even dreamed of all of this!

B would necessarily point out that the enormous growth of our ideas in modern physics is due to techniques and experimental devices which have done for modern physics what the telescope did for astronomy, the microscope for bacteriology, the spectroscope for all sciences. The outstanding modern devices are the Wilson cloud chamber, which enables us to see the path of an atom or electron, the electrometer, the Rutherford-Geiger-Müller tube, which has extended our ability to measure small electric currents (one electron a minute) a millionfold, the Lawrence and Livingston cyclotron, which enables us to hurl atoms about as in a sling shot with enormous speeds. And the electron tube—what has it not done for all science and human relations; the amplifier that has made possible the measurement of minute currents in the brain, the oscillator that generates electric waves of all frequencies, the device that has made possible instantaneous intercommunication between all peoples on this earth, the necessary component of a thousand modern devices—has it no place in the evolution of physics?

So physics, starting with Archimedes' lever and with the extremely limited world of the tangibles, has reached out "farther than ever comet flared or vagrant stardust swirled" and has bored into the minutest realms which the mind can picture. Always rigid and exacting, it has led the human race into our modern fairyland.

GORDON FERRIE HULL

DARTMOUTH COLLEGE

FOLSOMOID POINT FOUND IN ALLUVIUM BESIDE A MAMMOTH'S BONES

UNDER conditions similar to those of other recently reported finds[1, 2] mammoth bones and a Folsomoid

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[1] J. D. Figgins, *Proc. Colo. Museum Nat. Hist.*, 12: 2, 4–8, plates 1–2, 1933.

[2] E. H. Sellards, *Bull. Geol. Soc. Amer.*, 49: 999–1010, plates 1 and 3, July 1, 1938.

point have been found together in a locality about thirty miles southwest of Abilene, Texas. This site lies on a dry branch of Mulberry Creek, where an alluvial cap on bed-rock has been eroded by the channel of the stream.

The site was discovered by Cyrus N. Ray in July, 1929, and reported by him in 1930 as a locality where he had found channeled points.[3] In that report several generalized Folsom and other flint artifact types found in this place were described, and illustrated, as well as the center of one Folsom point similar to those found at the original locality.

In this site in 1935 Ray found a mammoth's skeleton embedded in a hummock of gravelly earth overlying bed-rock[4] and with the assistance of Dr. E. H. Sellards and Dr. Otto O. Watts, the mammoth's teeth were removed. At that time only a small excavation was made in the bank, of sufficient size to remove the teeth.

On July 4, 1938, while on an inspection tour of the deeply buried sites discovered by Cyrus N. Ray, Kirk Bryan and Samuel Vaughan were conducted to the site, and while Bryan and Ray were inspecting the outcropping bones, Vaughan noticed about an inch of the exposed base of a flint dart head firmly embedded in the red earth of the bank, on the same level as the bones, and on the north edge of the small hole excavated by Drs. Sellards, Ray and Watts in 1935.

Although smaller, the point is of the same general appearance as those reported and figured by Figgins and Sellards in recent publications. It is distinctly different from most of the points found with bison at either the original Folsom locality or at the Lindenmier site.[5]

On July 14, Ray and Bryan began a joint excavation at this place, which was directed by T. N. Campbell, assisted by Vaughan and some local laborers.

A trench 40 feet long was dug, and additional shallower holes were made to expose the bones. Only one flint chip was found. The number and disposition of the bones show that they were brought to place by the stream that deposited the gravel enclosing them and the finer-grained reddish alluvium overlying them. The Folsomoid point must have been carried by the same current. The alluvium of this locality overlies bedrock and has a variable thickness reaching 10 feet. It is hard and compact with limey concretions and thus has a considerable antiquity. It is an interesting speculation that the Folsom point may have been located in the fleshy part of the head, but the excavation of the site affords no definite evidence to this effect. It is, however, fair to conclude that the Folsomoid point is as old as the mammoth-bearing alluvium, which also contains remains of other, as yet unidentified, animals.

CYRUS N. RAY

ABILENE, TEXAS

KIRK BRYAN

HARVARD UNIVERSITY

STILBOMETOPA PODOPYSTYLA (HIPPOBOSCIDAE) FROM THE MOURNING DOVE

IN September, 1937, a specimen of *Stilbometopa podopystyla* Speiser was collected from a mature eastern mourning dove (*Zenaidura macroura carolinensis*) taken in the vicinity of Peru, Nebraska. The species determination was made by Dr. Alan Stone, of the U. S. National Museum, and the specimen was later deposited in the collection of the Museum of Comparative Zoology at Harvard University.

A search of the literature reveals only two other records of hippoboscid flies from North American doves. Bequaert[1] records the same fly (*S. podopystyla*) from a white-winged dove, *Melopelia asiatica* (L.), and Herman[2] collected *Ornithoica confluenta* Say from mourning doves taken on Cape Cod.

The finding of hippoboscid flies on mourning doves is of interest in that the natural vector of their Haemoproteus parasites has not been determined, although certain species of these flies are known to be vectors of the pigeon and quail Haemoproteus, and Huff[3] has shown experimentally that the pigeon fly (*Pseudolynchia maura* Bigot) can transmit the dove Haemoproteus to the pigeon.

G. ROBERT COATNEY

U. S. PUBLIC HEALTH SERVICE

QUOTATIONS

COOPERATION BETWEEN THE BRITISH AND AMERICAN ASSOCIATIONS

IT is probable that Lord Rayleigh's term of office will mark one of the most momentous periods in the long history of the British Association. To take the initiative in forming a division to deal with the social and international relations of science is to undertake an onerous and responsible task for which the association is peculiarly fitted, and in which it will have the good wishes of all who realize the effect that advances in science may have, for good or ill, on the welfare of our own community and of the nations of the world at large. As the Council of the Association does not meet until November, the General Committee, at its final meeting at Cambridge, approved the appointment of a provisional committee, and a few possible members of this committee were suggested to be invited to serve upon it. The publication of a list of the names of these members as forming even a provisional committee is, however, premature and unauthorized.

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[3] Cyrus N. Ray, *Bull. Texas Archeol. and Paleont. Soc.*, 2: 45–46, plate 10, Sept., 1930; Nos. 3, 4, 5, 6, 7 and 10.

[4] Cyrus N. Ray, *Bull. Texas Archeol. and Paleont. Soc.*, 7: 127–129, plate 17, 1935.

[5] F. H. H. Roberts, Jr., "A Folsom Complex," Preliminary Report on Investigations at the Lindenmier Site in Northern Colorado, Smithsonian Institution, 1935.

[1] Bequaert, *Rev. de Ent.*, 5: 322–325, 1935.

[2] Herman, *Bird-Banding*, 8: 161–166, 1937.

[3] Huff, *Amer. Jour. Hyg.*, 16: 618–623, 1935.

The Cambridge meeting has been signalized by yet another advance of international importance. The American Association for the Advancement of Science has aims and interests which have much in common with those of the British Association, and it has long been felt that a closer liaison between the two associations would hasten the realization of those ideals of international cooperation and good will and would form a very considerable contribution made by men of science to the cause of world peace.

By a happy chance, the principal officers of the American Association were able to be present at the Cambridge meeting of the British Association, and they have agreed to transmit to their executive two suggestions, which have the full approval of the General Committee of the British Association, for promoting a closer union between the two associations. It is suggested that, in alternate years, a disinguished American man of science should be invited to deliver an address before the members of the British Association at their annual meeting, and reciprocally, in the years not marked by such lectures, that a distinguished British scientific worker should address the members of the American Association at their summer meeting.

These addresses, which will be devoted to a topic of broad scientific interest, will usually, but not necessarily, deal with some of those aspects of science and society which are the concern of the new Division of the British Association.

Further, the officers of the associations are anxious that the associations, through their members, should have more intimate knowledge, each of the other's work. As a beginning to that end, it is suggested that a number of those actively engaged in the work of either association, as members of council or otherwise, should be elected to membership of the sister association, with the full privileges of attendance at meetings and of reception of journals.

This principle of exchange of the privileges of membership may be greatly extended in the future; but, in this connection much will depend on the form taken by the new quarterly journal which will replace the present annual report of the British Association after the publication of the report of the Cambridge meeting.

The associations are to be warmly congratulated on their courage and initiative in taking these steps, steps which are obviously but the beginnings of others which will lead to greater understanding and closer cooperation, with corresponding repercussions on the friendship between two great democratic communities.—*Nature.*

BOOKS AND LITERATURE

NEW TRENDS IN GERMAN FORESTRY

German Forestry. By Franz Heske. New Haven: Yale University Press. $3.00. Pp. 342. 1938.

Under ordinary circumstances, a book on German forestry would hardly be of sufficient general interest to be reviewed for scientific readers in America. German forestry has often been interpreted to the American people. Dr. B. E. Fernow at Cornell and Professor Filibert Roth at Ann Arbor were the early leaders in the forestry movement here, and richly contributed to development in this country of the concept of forests as a permanent renewable resource. As a matter of fact, all the early American literature on forestry is based to a large extent on the teachings and text-books of German foresters.

The present book, however, is an outgrowth of entirely changed conditions. It has a peculiar history back of it. For the last four or five years, the Oberlaender Trust and the Carl Schurz Memorial Foundation—the latter symbolic of the days of German liberalism—have sponsored and financed visits to Germany and Austria of *selected* groups of American lumbermen, governmental forest officials, and individual foresters of prominence. Dr. Franz Heske, a professor at the forest school at Tharandt, has acted as director, guide and "interpreter" on most of these visits. A group of American lumbermen, after one of these trips, thought to present their impressions in the form of a book for the benefit of forest owners and foresters in this country. They have not carried out this plan, but Dr. Heske, who had previously visited the United States under the auspices of the Oberlaender Trust, has undertaken, on their behalf, to interpret present German forest policies to the American public.

This interpretation, originally written in German, has been translated into English by Professor A. B. Recknagel, of Cornell University, edited by W. N. Sparhawk, of the U. S. Forest Service, prefaced by Henry S. Graves, dean of the School of Forestry in Yale University, and supplied with an introduction by R. B. Goodman, a forest land owner. The result is a superbly printed and illustrated book of some 340 pages, devoted in part to the historic, technical and economic aspects of German forests and forestry and in part to a discussion of German forest policies.

The *statistical and technical discussion*, which has been summarized clearly and in a masterly fashion, is not new, except for the strong defense by Dr. Heske of private ownership of forests—a defense which colors the entire book—and the stock argument implied as to Germany's need for greater natural resources.

Dr. Heske's views on private forestry are in striking contrast with those of the older generation of German foresters. They may be gleaned from a few direct quotations:

State forest ownership through "complete elimination of individual striving for profits and of the attendant exertion of the highest efficiency and initiative threatens to produce a schematic and uniform technique and a bureaucracy" (p. 107).

"Socialization [of forests] . . . is usually directed mainly against the larger private holdings, many of which are well managed. On the contrary, for tactical and political reasons it exempts the small private holdings, the management of which leaves much or everything to be desired". (p. 108).

This immediately brings up the vision of the huge areas of devastated forest land of our own large timber owners and the still-persisting small farm woods which, in increasing amounts, are contributing raw materials to our forest industries.

And again, socialization "breaks the natural ties that bind creative individuals to their work and which form *the basis of all culture and ethics*.[1] With the breaking of these ties . . . a people finally sinks to the level of lazy usufructuaries" (p. 108).

Dr. Heske, however, is not altogether for totally unrestricted private ownership of forests. What he advocates is a "socially oriented" private economy "that will advance the interests of society through the highest development of personal individuality and initiative" (p. 105). Such a condition, according to him, obtains in the case of *entailed* private forests, the legal peculiarities of which consist in "the prohibition of the sale of the property, the obligation to maintain its substance unimpaired, the prohibition against division by inheritance. . . . The incumbent proprietor has possession, control, and the usufruct. The income from the property is his to dispose of. The substance may not be touched by him or impaired by neglectful management. For the forest this means the fundamental requirement of strictly sustained-yield management" (p. 102). Such entailed forests, according to the author, are "models of forest management" and best serve the social needs of the community. What this means in actual practice is the preservation of the large ancestral estates and the extension of the same "entail principle" to medium-sized farmer estates. The hereditary farmstead law of 1933 seeks to accomplish this by perpetuating the ownership in such land without curbing "individual striving for profits."

It is, however, the discussion of forest policies that holds the greatest interest. There are certain goals which are accepted as desirable and essential in either a democratic or a totalitarian state; in forestry, for instance, land management on a permanent basis, stability of ownership of properties as an essential condition to such management, creation of opportunities for employment with attendant stabilization of rural communities, etc. The method, however, by which such goals may be attained depends on the social objectives of the governing class. In the one case, these goals are attained by taking into account the needs of the masses, with the benefits accruing to society as a whole. In the other, the tendency is to benefit a small minority, the large landowners, thus impoverishing the masses and enslaving the workers. All such measures must be considered in connection with the social effects which ultimately determine their real value. Foresters who are interested only in conservation of forests, as such, may fall for Dr. Heske's arguments and overlook their social implications.

Forestry in Germany is the outgrowth of a long historic development, in which density of population, scarcity of natural resources and survival of remnants of the feudal system have played their part. It is true that forests are managed as a continuous crop and provide definite employment to the villages, thereby contributing to their permanent existence. The contrast, however, between the squalor and pitiful income of the villagers and the "abundant life" of their landlords, strikingly emphasizes the *undemocratic* basis of this relationship. The new régime, with its policy of retaining the large landlords in full possession of their ancestral estates and privileges, its insistence on private ownership of the natural resources, its rigid fixity of occupation, fixity of residence and fixity of remuneration of the rural worker, marks a return in land use to the feudal system in its modern version—monopoly capitalism.

Yet Dr. Heske asserts that this is the only way out of "the liberal capitalistic economy of the 19th century, with its *laissez faire* philosophy, [which] has been followed by a demand for the extreme measures of a schematic State-controlled economy" (p. 104). This way out has involved the abolition of trade unions, the prohibition of collective bargaining and the breaking-up of all resistance on the part of the workers. For these safeguards, abstract concepts of "individual enterprise as a social organism" and the principle of leadership and confidential councils have been substituted. These are nothing but new social instruments for old ends, namely, the destruction of democracy.

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[1] The italics are those of the reviewer.

The author frankly admits that the principle of leadership means that "all power to make decisions resides in the leader of the enterprise—the employer." In forest enterprises "the leader will be either the forest owner or the forest officer" (pp. 226 and 227). He also claims that the social interests of the worker have always been fairly well safeguarded in German sustained-yield forest enterprise, omitting to mention that the women and children are forced to work in the forests because the head of the family is unable to earn a living wage. He further fails to mention that since the advent of the NSDAP the rural and forest workers have been deprived of almost all freedom of movement, and have been subjected to the competition of unemployed from the cities. The "bounden duty" of such workers, riveted to the land, is to do whatever their self-appointed "leaders" tell them to do. The bucolic paradise which Dr. Heske holds out as the ideal for us to emulate is thus nothing more than chattel slavery and feudal serfdom.

How well the "leader principle" has worked out may be gained from the fact that in the woods industry, for instance, the average hourly rate of wages for skilled labor, male and female, has dropped from 111.2 Reichspfennigs in 1931 to 79.3 Reichspfennigs in 1936. For unskilled labor, it has been reduced from 91.3 Reichspfennigs in 1931 to 62.0 Reichspfennigs in 1936. (These figures are quoted from the National Industrial Conference Board's report "Economic Development of Germany under National Socialism." Study No. 236, pp. 33–60. New York, N. Y.). Truly, "the concept of the new labor law finds a ready soil in German forest enterprises" (p. 230). It is, therefore, somewhat understandable why American forest owners would be interested in having this interpretation of German forest conditions made available to American foresters. Why foresters, some of them high in the public service, should be active participants in helping to indoctrinate our forestry profession with this new ideology is much more difficult to understand or to explain.

There is one peculiar deviation from the general spirit of the book. This is the discussion of the "freedom of science," almost passionate in tone, which leaves much to the imagination and conjecture of the reader. "An important, yes, an almost sacred fundamental characteristic of science, including forestry science," says Dr. Heske, "is freedom. Without freedom, science becomes a farce." And again, "The discovery of truth requires that science be absolutely free from compulsion and tutelage, for the ways of science are determined only by the search for truth, and must be neither anticipated nor influenced from without." And so on for two and one-half pages (pp. 205–207), without a single reference to the status of science in Germany.

This discussion is sandwiched in between a rather glowing account of the status and scope of forestry science and one of forest research in Germany. It is followed by a chapter on forest education, in which the author points out Germany's advantages as a center for forest education for foreign students.

A few pages later, he states, "Thus far, the fear that the forestry authorities would cramp the professors engaged in directing research with troublesome instructions and thereby encroach upon the freedom of research has proved groundless." The implication, therefore, is that science in Germany is free and that the admonition to be "on guard to keep the endeavors of science free from partisan influences" is really meant only for us. Or may it not be a spontaneous outcry of a tortured scientist's soul (shade of Freud) protesting against making all science in Germany the handmaiden of inspired truth!

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SPECIAL ARTICLES

THE CAPSULAR POLYSACCHARIDE OF THE TYPE XIV PNEUMOCOCCUS AND ITS RELATIONSHIP TO THE SPECIFIC SUBSTANCES OF HUMAN BLOOD

Recently in this journal, Finland and Curnen[1] have called attention to a number of untoward clinical reactions manifested by hemoglobinuria, and even death, following the intravenous administration of Type XIV antipneumococcal horse serum. Examination of 19 different specimens of horse sera of this type revealed in every instance agglutinins for human erythrocytes in high titer, whereas only two of 41 specimens of sera of other types agglutinated human red blood cells in dilution of 1:20 or higher. This distinction is not shared by Type XIV rabbit serum.

Since the phenomenon of erythrocyte agglutination is peculiar to Type XIV antipneumococcal horse serum it was thought that an investigation of the properties of the capsular polysaccharide of the Type XIV pneumococcus might reveal points of similarity with the blood group specific substances, and at the same time shed light upon the mechanism, whereby antipneumococcal horse serum of this particular type agglutinates human erythrocytes.

Two possible explanations for the observed effects on human red blood cells suggest themselves: (*a*) That the Type XIV Pneumococcus, owing to some peculiarity in structural makeup, might adsorb selectively from the culture media sufficient blood group substance to act antigenetically in the horse to produce agglutinins against human erythrocytes, since it has been shown that the blood group A specific substance is present in commercial peptone and broth media;[2, 3] (*b*) that the chemical constitution of the Type XIV polysaccharide is sufficiently akin to the blood group substances to produce agglutinins against human erythrocytes, simultaneously with the production of type specific pneumococcal antibodies. The latter hypothesis seemed more tenable, since it is somewhat gratuitous to assume that adsorbed blood group A substance would thus be rendered antigenic. Furthermore, if this were the case, the hemagglutinins engendered would be specifically directed toward the erythrocytes of blood group A.

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[1] M. Finland and E. C. Curnen, Science, 87: 417, 1938.

With this concept in mind, the authors have prepared the specific capsular polysaccharide from Type XIV pneumococci in the following manner: A human strain of Type XIV pneumococcus, recently isolated, was passed consecutively until 0.1 cc of an eight-hour culture was consistently lethal for mice in from 8 to 12 hours. Meat infusion broth, containing 0.1 per cent. dextrose and 1.0 per cent. Witte's peptone, was seeded with a culture of this organism and, after six hours, the living bacteria were collected in a Sharples centrifuge. The organisms from 50 liters of culture were resuspended in saline and allowed to autolyze at 37.5° C. for 72 hours. The gram-negative bacterial detritus was removed by centrifugation and the clear supernatant liquid concentrated to 500 cc *in vacuo*. Protein was removed by adjusting the pH of the solution to 3.78 followed by centrifugation. The specific polysaccharide was then precipitated by the addition of 1.5 volumes of alcohol. Solution and reprecipitation were repeated several times. The protein-free product was finally isolated as a white amorphous substance which showed the following properties:

The substance was soluble in water to approximately 1 per cent. Tests for uronic acids were negative, as were protein tests with picric and trichloroacetic acids. Copper acetate, mercuric chloride and uranium nitrate caused no precipitation. Partial precipitation occurred upon the addition of basic lead acetate and barium hydroxide solutions, and a heavy precipitation was obtained with tannic acid. The material gave negative biuret, ninhydrin, sulfosalicylic acid, Hopkins-Cole, Millon's and xanthoproteic reactions. The Molisch test was extremely strong, as were tests for amino sugars.[4] Analysis of a dried sample of one preparation showed: C 44.4 per cent., H 6.8 per cent., N 5 per cent., acetyl 9.0 per cent., reducing sugars (calculated as glucose) 74 per cent., amino sugar 62 per cent., and specific rotation $[\alpha]_D = +12.5$. Serologically, the material reacted with Type XIV antipneumococcal horse and rabbit sera in dilutions as high as 1:4,000,000. That the type specific polysaccharide is neither identical nor contaminated with the blood group A substance is evidenced by the fact that the bacterial polysaccharide does not appreciably inhibit the lysis of sheep cells when the latter are added to anti A serum in the presence of complement.

The group A substance is the only specific substance of the human blood cells which has been carefully investigated chemically, although recent studies of the remaining blood group substances reveal points of similarity.[5, 6] A comparison of the properties of the Type XIV pneumococcus capsular polysaccharide with those of the blood group A specific substance isolated by Landsteiner from horse saliva[7] and commercial pepsin[8] shows many points in common. Save for the biuret reaction, the group A substance gives almost identical qualitative tests and approaches closely in elementary analysis, acetyl content and specific rotation the capsular polysaccharide of Type XIV pneumococcus. It would seem from the properties already described that the capsular polysaccharide of Type XIV pneumococcus in its natural state, as a part of the intact bacterial cell, may well possess sufficient chemical and immunological relationship to the blood group specific substances to incite in the horse the formation of agglutinins for human erythrocytes, simultaneously with the production of other type specific antibodies. An analogous situation exists in the common immunological properties of the Forssman substance and the polysaccharide derived from the Shiga bacillus, both of which in their antigenic forms incite the production of hemolysins for sheep erythrocytes and, as happens, act interchangeably in inhibiting the hemolysis of sheep cells.[9]

In the case of the Type XIV pneumococcus these concepts are strongly supported by observations made in this laboratory, that the blood group A specific substance gives a vigorous precipitin reaction in the cold with Type XIV antipneumococcus horse serum, the reaction still being detectable in dilutions of 1 part in a million. In Type XIV antipneumococcus rabbit serum,

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[2] F. Schiff, *Zeits. für Bakt.*, Ref. 98, Abt. 1, 94, 1930.

[3] Walther F. Goebel, *Jour. Exp. Med.* (in press).

[4] L. A. Elson and W. T. J. Morgan, *Biochem. Jour.*, 27: 1824, 1933.

[5] C. Hallauer, *Zeits. Immunforsch.*, 83: 114, 1934.

[6] J. R. Marrack, "The Chemistry of Antigens and Antibodies," p. 105, Medical Research Council Special Report, Series No. 230, London, 1938.

[7] K. Landsteiner, *Jour. Exp. Med.*, 63: 185, 1936.

[8] K. Landsteiner, *ibid.*, 63: 813, 1936.

[9] K. Meyer and W. T. J. Morgan, *Brit. Jour. Exp. Path.*, 16: 476, 1935.

however, no cross reaction with the specific blood group A substance occurs, even in the cold. This is further evidence of the greater specificity of the antibodies produced by the rabbit, as compared with those formed by the horse, and would seem to offer an explanation for the observation made by Finland and Curnen that Type XIV antipneumococcus horse sera agglutinate human erythrocytes in high titre, whereas Type XIV antipneumococcus rabbit sera do not.

The relationship of the pneumococcus Type XIV specific polysaccharide to the blood group specific substances is further substantiated by the fact that absorption of Type XIV antipneumococcal horse serum with homologous polysaccharide removes the hemagglutinins for all blood groups.

Further studies on the chemical nature of the Type XIV pneumococcus polysaccharide and its chemo-immunological relationship to the blood group substances are in progress.

In conclusion the authors wish to express their thanks to Dr. Karl Landsteiner for his generous counsel.

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ULTRA-VIOLET ABSORPTION SPECTRUM OF CATALASE

THE absorption spectrum of catalase obtained from horse liver shows maxima at 4090, 5050, 5400 and 6220 Å.[1] The preparation in the air-driven quantity-ultracentrifuge[2] of solutions of catalase which appear to be homogeneous both upon ultracentrifugal[2] and electrophoretic[3] analysis has made possible the measurement of the absorption spectrum of the enzyme in the ultra-violet region.

The curve shown in Fig. 1 was obtained with a small Hilger quartz spectrograph and a Spekker spectrophotometer. The light source was a tungsten steel spark. The curve shows maxima at about 2,750 and 4,050 Å. The peak at 2,750 Å is due to the protein carrier of the enzyme, while the maximum at 4,050 Å is caused primarily by the hemin residue. A maximum in the ultra-violet region has previously been found in less highly purified catalase preparations.[4]

The values of the extinction coefficients at the two maxima, as calculated by the formula $\varepsilon_{1\ \mathrm{mM\ Fe\ per\ liter}} = \frac{D}{d.c}$,[5] where D represents the observed optical density (see Fig. 1), d the thickness of the absorption cell (1 cm) and c the concentration of the enzyme in terms of mM Fe per liter, are $\varepsilon_{2,750 Å} = 185$ and $\varepsilon_{4,050 Å} = 80.5$.[6]

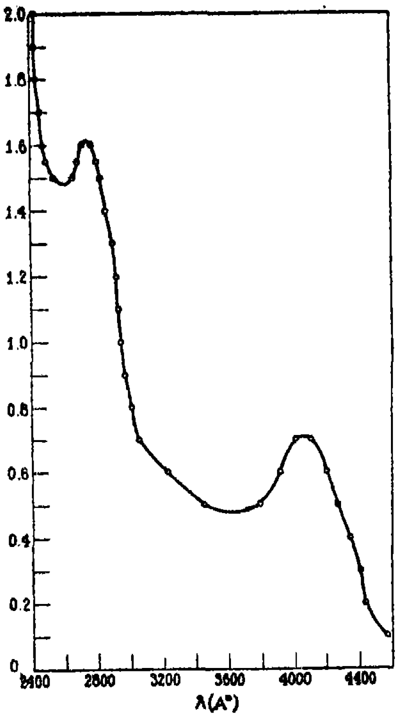

FIG. 1. Ultra-violet absorption curve of horse liver catalase. Solvent, 4.10^{-3} M. Phosphate, pH 8. Concentration of enzyme, 0.6 mg. per cc; of porphyrin-bound iron, $8.7 \cdot 10^{-6}$ M. Abscissa, wavelength in Angström units; ordinate, optical density $D = \log I_0/I$).

In contrast to other hemin-containing proteins, such as hemoglobin, chlorocruorin and the respiratory ferment, the value of the extinction coefficient at 2,750 Å, which is due to the protein component, is greater than that at 4,050 Å. This reversal in magnitude is probably due to the fact that in hemoglobin the mass ratio of hemin to protein is 2,600/68,000, while in catalase it is 2,600/250,000,[2] thus diminishing the quantitative contribution to the light absorption made by the four porphyrin groups present in these molecules. The underlying assumption is that the total content in aromatic amino acids in these conjugated proteins is of the same order of magnitude.

The visual examination of photographic plates obtained with the aid of a hydrogen discharge tube and a small Hilger quartz spectrograph reveals a band structure[7] typical for a globulin. There appear to be present bands due to tryptophane, tyrosine and phenylalanine. The verification of this observation by chemical analysis will have to await the preparation of sufficient amounts of homogeneous catalase.

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[1] K. G. Stern, *Jour. Biol. Chem.*, 121: 561, 1937.

[2] K. G. Stern and R. W. G. Wyckoff, SCIENCE, 87: 18, 1938, *Jour. Biol. Chem.*, 124: 573, 1938.

[3] Unpublished.

[4] K. G. Stern, *Zeits. physiol. Chem.*, 212: 207, 1932.

[5] D. L. Drabkin and J. H. Austin, *Jour. Biol. Chem.*, 112: 51, 1935–36.

[6] This value is lower than that previously reported on the basis of photo-electric spectrophotometric records obtained from other enzyme preparations (see note 1).

[7] G. I. Lavin and J. H. Northrop, *Jour. Am. Chem. Soc.*, 57: 874, 1935; see also C. B. Coulter, F. M. Stone and E. A. Kabat, *Jour. Gen. Physiol.*, 19: 739, 1936.

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THE ANTIGENIC STABILITY OF WESTERN EQUINE ENCEPHALOMYELITIS VIRUS

IT has recently[1] been shown that an especially potent vaccine against equine encephalomyelitis can be prepared from formalinized chicken embryos. The solid immunity that can be conveyed both to guinea pigs and horses[2] with such a vaccine provides a simple way of studying many properties of the virus responsible for this disease.

It is possible to determine in this fashion whether the virus remains the same from year to year and whether it is greatly altered by passage through different animals' hosts. Such information is essential whenever we seek to protect by vaccination, either with live or killed virus vaccines. It is especially important in the case of encephalomyelitis, because two varieties are already known to exist in the United States. One is active east, the other west of the Appalachian mountains. By all tests these two strains are as unrelated antigenically as two different diseases; an animal immunized to one has not lost any of its susceptibility to the other. We have been studying the homogeneity and stability of the western strain virus by testing the immunity of vaccinated animals to virus derived from as widely different sources as possible.

The guinea pigs for these experiments have been vaccinated with two 0.5 cc doses of chick embryo vaccine injected subcutaneously at an interval of a week. Two weeks after the second injection their immunity has been tested by the intracerebral inoculation of 100 to 1,000 lethal doses of virus. Previous experiment[1] has shown that such animals are completely protected against massive intracerebral inoculation with the virus from which the vaccine was made. In our tests two vaccines have been employed. The viruses for both were derived from the brains of horses dying during the epidemic of 1933.[3] One has been passed uninterruptedly through guinea pigs, the other has been through both guinea pigs and horses. No differences in behavior could be seen between the two vaccines. Guinea pigs vaccinated with them have been inoculated with the following strains of virus: (1) Guinea pig passage virus from 1933 brains; (2) the same virus after 60 egg embryo passages; (3) virus[4] from a 1933 brain after five years of uninterrupted mouse passage, and (4) 1937 field virus after several passages through guinea pigs. One of these 1937 viruses[5] was from Iowa, the other from Texas. The vaccinated animals have been completely protected against each of these viruses. It is thus apparent that the virus of western encephalomyelitis has not been greatly altered in its antigenic structure by transfer to guinea pigs, mice and chicken embryos. The fact that a vaccine gave complete protection against viruses from localities as widely separated as Iowa and Texas proves that this disease is substantially the same in different parts of the country in which it occurs; since vaccine made with 1933 virus protects against 1937 viruses, we may be confident that vaccines made with previous years' viruses will be effective against the disease that is now epidemic in several mid-western States and Canada.

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[1] J. W. Beard, H. Finkelstein, W. C. Sealy and R. W. G. Wyckoff, SCIENCE, 87: 89, 490, 1938.

[2] B. M. Lyon and R. W. G. Wyckoff, *Veterinary Medicine*, 33: 408, 1938.

[3] We are indebted to Dr. B. M. Lyon for these viruses.

[4] We are indebted to Dr. P. K. Olitzky, of the Rockefeller Institute, for this strain of virus.

[5] These virus brains have been obtained from the Bureau of Animal Industry, U. S. Department of Agriculture, through the kindness of Dr. L. T. Giltner and Dr. M. S. Shahan.

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THE CHANGING VALUES OF SCIENCE[1]

By Dr. R. C. WALLACE

PRINCIPAL OF QUEEN'S UNIVERSITY, KINGSTON, ONTARIO

THERE is no need to elaborate the assertion that changes of emphasis are taking place in our time in the values of science. This has been a matter of perception and of observation. Men whose responsibility it is to make contributions to the advancement of their own fields of science have felt the change. Others who are not scientists have spoken about it, and have not infrequently misunderstood its meaning. It is a formidable task to endeavor to interpret the changes which are taking place, more particularly because we are in the middle of the current. We have not a position of objective independence. But it is of value to the speaker at least, whose day-by-day thinking is perforce confined to the field of educational values, to clarify in his own mind the shift in emphasis and in meaning which science, as a tool of thought, is experiencing before our eyes. It may not be out of place to take the occasion of the Hector Maiben lecture, which you have honored me with the invitation to deliver, for the presentation of such thought on this subject as I may be able to place in coherent sequence.

It is, after all, somewhat of a paradox that there should be any change of attitude in the scientific way of thinking. So much of the contribution of science in the last three centuries is a permanent readjustment of the thought of mankind and is not subject to change. The rationalism of the scholastics of the middle ages gave way under the revolt of the Renaissance, and the growing demand for facing facts. It was this demand which led to the development of modern science, and to its great victories in the exploration of nature and the harnessing of her forces for the use of man. When he finished his treatise on the "Principles of Psychology," William James wrote, "I herewith forge every sentence in the teeth of irreducible and stubborn facts." James's was the scientific method. Since the time of Roger Bacon, the scientist has forged every sentence in the book of exploration "in the teeth of irreducible and stubborn facts." He has persuaded the world to adopt the same method in all departments of knowledge, no matter whether related to science or not. The historian, the sociologist, the psychologist, the theologian wrestle with stubborn and irreducible facts because the scientist has shown in his field of work that they must be faced and accounted for. There has grown up an attitude of intellectual honesty which has had a cathartic value in clearing away the unrealities which had worked themselves into the rationalism of the pre-Renaissance period.

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[1] The Maiben Lecture delivered at the meeting of the American Association for the Advancement of Science, Ottawa, June 30, 1938.

Further, there has developed under the hand of the scientist a technique of obtaining the pertinent facts. Facts do not come of themselves. They must be sought for under controlled conditions, or under conditions which, if not controllable, are fully understood. The experimental sciences have provided the means wherewith to ascertain facts under controlled conditions. They have had their special sphere in the physical realm; but the biologist has used the experiment with amazing success in the less easily controllable field in which he operates. In the sciences which deal with man, and in social studies of all kinds, the experiment is less readily applicable, and the student is forced back on the study of the conditions under which the data accumulate. These conditions may be unplanned, but they must be known. The scientist has shown how to disentangle the significant conditions from the adventitious. He has placed facts in their setting in the flow of events.

In this whole process an intellectual habit has been created. Through the path of science we may not yet have traveled far in answer to the quest of the "why," but we have gone very far in satisfying the question as to the "how." We have acquired the habit of mind—and it has become almost intuitive—of finding out under what conditions this or that thing takes place. We assume an orderly process in nature; and we determine the order in each particular circumstance. Within the limits in which scientists work, the assumptions have been justified in a practical way by the results. Science has acquired a prestige in the modern world, not so much from its intellectual attitude, but because of the contributions which the scientist has made to the amenities of living. In the things that we eat and drink, in the clothing wherewith we cover ourselves, in our communication and our traveling, in our amusements and our recreations, we lean on the scientist at every turn. He has become indispensable. In his understanding of nature's laws and in his using of the knowledge to the satisfying of the needs and the desires of man, he has shown results which convince. He has become respectable and even respected. A practical age demands a sign which it can understand. That sign has been given with convincing iteration.

It seemed in the nature of the case inevitable that the new tool and the new method of science should give rise to a mechanistic conception of nature's processes, whether in the inanimate or in the animate sphere. Under similar conditions, similar phenomena occurred. The physicist would be prepared to go even further, for his is, from the experimental side, the most exact of the sciences. His formulation would be: Under the same conditions, the same phenomena occur. Precisely the same conditions do not occur; nor can they be made to occur by even the most skilful experimenter. But the basic conception of the uniformity of nature's processes has served the scientist so well as a working philosophy that it has been taken to be, to all intents and purposes, a fundamental truth. Without it, all experiments would cease; for results could have no meaning. And it was of purely philosophic interest whether certain conditions caused certain phenomena to occur, or whether, as Hume would have it, the relationship is simply that of time sequence. To the scientist it was enough that he could count on the sequence, and it was simpler to use the phraseology of cause and effect. Such a system, closed and complete, works as a machine. There may be an awkward question as to the winding up at the beginning; and there have been the prophets who foresee an eventual running down to a dead stop; but for our time it goes, and goes inevitably by the force within itself. Not only in the physical world is this the case. The biological processes are physical and chemical; even the mental processes in man himself have a physical and chemical background. It has seemed logical, therefore, to many biologists and psychologists that the mechanism of the physical world operates with the same rigidity and inevitability in the living processes and in man himself. The behaviorists are the legitimate offspring of the mechanists. And if in the social relationships the operation of the mechanical principle has not yet been so clearly established as in inanimate nature, there has been the feeling that this is only because the factors are less easily analyzed, and that with the development of the social sciences the principle will be found to operate with the inevitability which is displayed elsewhere. The work of classification and analysis goes on. The statistician accumulates data in the field of sociology. Measurement has invaded the preserves of the educationist. There is no realm so intangible that the scientific tool may not find a hard surface on which to operate. There is no human problem so complex, as many think, that it may not ultimately resolve itself into the ordinary phenomena of causal conditions within the system, and the inevitable consequences of those conditions—in a word, a system working within itself in a mechanical process as rigid and unalterable as the movements of a clock under the force of its mainspring.

And yet, we have somehow felt not quite satisfied. The authority of science has been too convincing for complete conviction. It has overreached itself, and is in danger of falling on the other side. Good men suffer not infrequently from the excess of their virtues. Their goodness is too overpowering to be altogether real. In similar fashion, the underlying assumptions of the scientific method have been too complete to meet the case. They have left no room for anything else, and there is something else which the methods of science fail to elucidate. That is the reason for the reorientation and revaluation which is taking place to-day. In this readjustment the scientists are joining hands with the philosophers; for the task belongs not to science, nor to philosophy, but to science and philosophy together.

Overemphasis is something to which the mind is prone; and it is, to our way of thinking, a question of overemphasis with which we are dealing in the development and use of the scientific tool. We have been passing through a period of depression, which has given special significance to the dependence of man on his economic setting. If we were to judge from the discussions and the literature of the past eight years, we would be led to the conclusion that man is primarily concerned about, and influenced by, his economic relationships. We would be led to subscribe to the premises on which Marx erected his political philosophy. And yet we know that this is not the truth of the case. There are other, and more fundamental, springs of life and conduct than the economic. We have been under the spell of the overemphasis of a phase of the truth; and we are only gradually coming back to a sounder balance. So in the changing emphasis in the religious life, where in one age the dogmatic formulation is all-important, in another the social gospel prevails, in another the mystical approach. It seems difficult—indeed it may not be possible—to maintain through the ages an even balance. Truth seems to unfold itself by exposing the falsity of the over-statement of positions, which, within their own limits, are true.

There is a growing doubt as to the applicability of the scientific method in the study of human affairs, to the extent at least to which it has been used in the last quarter of a century. It is this doubt, as much as the recent discoveries in subatomic physics, which has raised the question that is before us this evening. It goes without saying that there is a great body of facts which can be accumulated, tested, analyzed, tabulated. These facts clarify situations otherwise vague, about which opinions are accustomed to be formed without the support of the necessary data. This process is essential; and only the trained scientist can do this work. But those among us who have to deal with some of the mental and emotional expressions of human activity have not felt assured. To take, for example, the field of education. Much has been done, and some of it of real value, in analyzing objectives and aptitudes and the specific values of this or that educational tool in developing the aptitudes which are needed for the various professions or vocations. In these investigations the scientific method and technique have been employed. The work has clarified the situation. It has given a sense of precision to an otherwise somewhat nebulous subject. But one is left with the feeling that there are values in education—and these the most important—that elude the pan of the balance. They are imponderable, but they are very real. Any one who has come under the influence of an inspiring teacher knows the things whereof I speak. They are the things which are felt, not said; and they are of the very essence of a liberal education. They are far beyond the power of analysis of the scientist, but they are understood by the scientist as a man. So too, for instance, in the progress of the study of sociology. Very much of real value has been accomplished by the detailed statistical studies which have been made in recent years. We understand better, and in a quantitative way, how people are affected in the mass by opinions and movements and habits. We are thrown back, however, on the fact that while in a general way mass movements may appear to be reduced to a quantitative basis, the individual unit is a human being of unpredictable responses and reactions; and there are values in sociology as in education which elude the precision methods of the scientist. In economics, too, the conviction grows on the layman that the discrepancies between theory and fact which have been in evidence in recent years are to be explained by the consideration that economic laws work not *in vacuo* but in and through human beings, who refuse to be treated as though they were robots working under purely mechanical forces.

Is it the case that the difficulty lies, not in the incompetence of science in this field of human affairs, but in the lack of knowledge of the complicated factors which operate in human life and thinking and conduct? Is there not so much to be explored before we can say so peremptorily that there are areas beyond the limit of scientific analysis? Will not the rapidly advancing knowledge of psychological processes change the situation? Can the scientist go forward at all unless on the hypothesis that the scientific method is applicable?

Or, on the other hand, are there values which are beyond the reach of the scientist *qua* scientist, and of which his method has no means of assessing the validity? This is the fundamental question; and we have discussed the human problem first because the question has arisen in many minds in recent years. There are scientists not a few who feel that as scientists they must go forward on the assumption that there are open fields still to be cultivated, but as men feel that there are regions, the door to which they will not be able to unlock by the key which science provides.

We shall return to this question. But what is the situation in the inorganic world, where the problems of life, ever more complicated as we ascend to the level of man, do not confuse the issue? Are there limitations here as well which have to be understood and defined; and what is the basis for establishing such limitations?

It would be incorrect to say that such limitations have been established. It would be nearer the truth to say that there are probably limitations. A quarter of a century ago a statement of even such a tentative nature might not have met with general support. The reason for the change is in the newer development of nuclear physics, where the principle of indeterminacy and the unpredictable movement of the electron around its nucleus have raised questions as to the rigidity of the physical mechanism. The reduction of any physical phenomena to a law of averages, in which the action of the individual particle, no matter how small, is not possible to predict, weakens the basis on which physical science has been built. Such a procedure may be useful in relating together the laws of the physical world, derived as statistical averages, with the laws of human behavior; but it does not strengthen the hands of the scientist who has been accustomed to work on the implicit assumption of rigid causality in the phenomena of nature.

Are we justified in basing philosophical conclusions on these newer findings in ultramolecular physics which seem to carry with them a certain air of indeterminacy? May it not be that further work will discover the factors which influence the movements which are at present unpredictable? Or must we accept the position and guide ourselves accordingly? It would seem to be dangerous to go far on the strength of data derived from the operation of non-observable phenomena. It might seem more advisable to urge caution in drawing conclusions until a closer approach has been made to the matter at issue. In the stream of literature which has poured forth on the subject in recent years, however, there has been general acceptance of the position that a new orientation is needed in our approach to the physical world, and that the scientist must guide himself accordingly. Let us examine some of the more important contributions which have been made towards an understanding of the world in this new setting.

Eddington accepts the indeterminacy which the modern findings of physics have proclaimed, and with it, as a necessary consequence, the relegating of the principle of causality to the dustheap. This is not to say, however, that it is a world of chaos with which we have to deal. Eddington does not go so far as to say that there may be a principle of volition in inanimate nature akin to that which he accepts in the realm of human consciousness. He bases his conception of the orderliness which may exist in nature on the statistical laws which hold good for nature's processes in the mass, whatever may be the capricious action of the minute individuals which make up the mass. It is the orderliness of the mortality rates of human beings, accurate for the purpose of insurance companies, but of no value to you or to me in forecasting our own span of life. But to him there is a world beyond those pointer readings which alone represent in our consciousness the expression of nature's working. The data of science are symbols of that of which we can not be conscious and which we are unable to apprehend. There is a mystical background in nature and in man which Eddington interprets, not as a scientist, but as a poet. Therein lie both the intangibility and the charm of much that he has written.

Eddington is a scientist with a philosophical outlook. Whitehead is a philosopher with a mathematical background. The approach of Whitehead is a different one to that of Eddington. Eddington's concern is to make clear the limitations under which the scientist works, and the reality of that other world, known only to our own consciousness and what we know of the consciousness of others, in which the intangible values hold sway. It is in effect a dualism, on the one hand of pointer readings which we build up into our body of scientific knowledge, on the other hand of values which come to us through other channels, but which commend themselves as enduring realities. Whitehead sees the special area in which the scientist works, but his concern is primarily to integrate this world of the scientist into the larger whole. He seeks for a representation of reality into which the inorganic and the organic world fit without distinction and without separation. To Whitehead all nature is an organism, of which that part known to science is only a part, but nevertheless an outward evidence of the inward whole. That nature is an integrated organism is an assumption which the philosopher, whose function it is to look out on truth in its most universal significance, may readily take as a premise to his thinking. It is the attitude of the poet, to whom all outward expression in nature is an indication of an inward spirit which pervades the world, and gives it meaning. It is no easy task for the uninitiated reader to understand the way in which Whitehead's organism functions. It is less difficult to understand that in the ultimate analysis there may be a harmony in which mere arbitrariness has no part; and in Whitehead's words "to know that the system includes the harmony of logical rationality, and the harmony of esthetic achievement: to know that while the harmony of logic lies upon the universe as an iron necessity, the esthetic harmony stands before it as a living ideal moulding the general flux in its broken progress towards finer, subtler issues."

It would serve little purpose to discuss all the interpretations of the world of nature and of man which have been given to us in recent years. May I limit our attention to one other, from a man with a scientific background very similar to that of Eddington. Herbert Dingle is unsympathetic to the positions taken both by Eddington and by Whitehead. Eddington he finds to be illogical in that he has taken the position that "the only subject presented to me for study is the content of my consciousness," while he has at the same time admitted the reality of the external world on which the scientist operates. He has thus been disposed to attribute an element of the mysterious and mystical to this outside world, because it is outside the realm of consciousness. Dingle considers this to be an unnecessary consequence of inadequate premises. Whitehead's assumption, on the other hand, that there is an organism in nature which rationalizes in itself all that is perceived and all that is felt, Dingle considers to be an assumption without proof. As a scientist he feels that, while ultimately this may be found to be the case, it can not be assumed in advance. His plan is to build up, if the facts justify it, a basis of rationality in the more limited areas which are available for exploration with the limited means at our disposal, and to work outwards from this central nucleus until eventually a field theory may be developed which will rationalize the whole of nature. Einstein has gone part of the way in this direction in his field theory of gravitation. Dingle takes the position that in the ordinary world of everyday experience causality rules, and common-sense judgments are found. The scientist, however, deals with concepts, idealized from the common-sense everyday world; and in the world of concepts time has no meaning, and causality consequently has no validity. The electron is a concept, mass is a concept, light is a concept. The function of the scientist is to interpret the memory of experiences by concepts and to correlate these concepts into ever-widening wholes. Science abstracts from the world of experience. The more complete the abstraction, the less the sense of reality in the concept which is created.

I am reminded, as I ponder over the position taken by this able astrophysicist, of a conversation with a prominent member of the somewhat revolutionary group of Canadian artists, popularly known as the School of Seven. The discussion was on the representation of a tree which stood prominently in the center of a bare northern landscape. To me the tree was unreal and almost fantastic. As a lover of nature I registered my protest. It was explained to me that the function of the artist is to see an inner significance, to abstract it from the setting and to depict it by itself alone. So too, it was stated, the poet finds an inner significance, separates it from its extraneous environment and presents it as a central truth, independent and alone. Somewhat the same method, if one interprets Dingle aright, is adopted by the scientist. The concept of the electron, like that of the tree in the Canadian painting, stands isolated and unreal to the world of experience. It is a symbol of a central truth; true in essence, but symbolic when viewed from the position of the ordinary world of everyday experience.

These three interpretations of the validity of the scientific method, sketchy and incomplete though this presentation of them necessarily is, are profoundly significant. It is to be expected that there will be no unanimity in the approach to truth; and Eddington, Whitehead and Dingle are far apart in their interpretations. Man gropes for the ultimate, and groping means exploration in all directions. But they have things in common, and two of them seem to call for special emphasis in a discussion of the values of science to a modern world.

It is very evident, in the first place, that the rigidly mechanistic conception of the universe, as it appeared to an earlier generation of scientists, has lost its force to-day. It is not in the thinking of the men to whom I have referred, nor to others of similar stature who, too, have gone deeply into the subject. This change has taken place partly because scientists are not prepared to insist on the principle of causality in the face of the recent findings in nuclear physics; but mainly because they are doubtful whether the method of the scientist is adequate to determine the whole of the processes of nature, even in the purely physical realm. There are many who would feel that, when further knowledge has been gained, the mechanical principle may yet prove to be the most adequate interpretation. There are few who would take the position that it is the only interpretation of the phenomena of the inanimate and animate world.

In the second place, there is a growing tendency to treat nature as a whole and to make no separation between the inanimate and animate world. Whatever explanation will ultimately be found to be adequate must prove to be adequate for the living and non-living alike. The mechanists endeavored to apply this principle to the whole of nature, and in so doing reduced man to an automaton. Freedom of choice disappeared in the process; and reason has rebelled against this explanation of the springs of our being. But it is felt that there must be a principle of rational operation of the world, and that man in all his activities, physical, intellectual, spiritual, will be found to fit into the plan as well as does the growing crystal. If there is not a closed system self-determining and working as does a machine, there must be a rational system, which the mind of man may yet be able to understand. The philosopher assumes that such a comprehensive system exists; the scientist feels that the proven area of rational operation is widening, and may some day include the universe in its scope.

These two positions, which seem to be representative of the thinking of our time, namely, that the mechanistic conception of the world is inadequate and that there will in all likelihood be found to be a rational basis applying to the inanimate and animate world alike—these positions have been taken because of a sense of values which has found inadequate interpretation under the old régime. Eddington has illustrated this sense of values in a memorable passage in which he describes his inner satisfaction in the contemplation of the ripples on the surface of a lake, touched by the afternoon sun; and by contrast his intellectual process in formulating the motion of the waves into a differential equation. Esthetic values seem to stand apart from the formulae of science. They must be accounted for. They must be accounted for in a wider synthesis in which science plays a fundamental part. And they must be accounted for not as an experience of human consciousness only. The glory of the afternoon sun over a lake in the northern woods, when it would seem that the very gates of heaven are rolled ajar and a fleeting glance is permitted of the eternal Presence—that glory is not in the mind of the worshipper only, and of no reality unless there is human consciousness to feel it. It is a value in nature, which goes back to a time when there was no human eye to perceive; it will be there when the procession of human beings has trod across this fleeting stage of time, and made the final bow to the audience of the stars. The quality of beauty resides in the essential fitness of things themselves, as in the mind attuned to perceive that fitness. The deeper values are universal, in and through nature, of which man is only a part. It is the great task of science to integrate these eternal values into a rational whole with the external phenomena of nature with which science has been hitherto more immediately concerned. Ultimately there can be no conflict; there can not even be a dualism. If truth has any meaning, it is that there is one truth, expressed it may be through many aspects, but blending into a unified whole. The tools adequate for the work of delving for this comprehensive truth must be shaped for the hands both of the scientist and the philosopher, for they must work together in this great quest.

In all our thinking we come back to the human sciences. It is in the realm of human activity and human aspirations that the ultimate test will be made. I have already indicated in the discussion that it is here that the gap between the findings of science and the whole truth has been felt to be greatest. It is here that the need for a clear understanding is most urgent. In the need for clearer thought as to ultimate values which we call good, whether in personal or social relationships, whether as formulated by legislation or by an inner moral law which finds no expression in words, can we advance to clearer criteria by the well-tried method which science has so successfully pursued elsewhere, or must we always be content to say, as the Earl of Listowel has recently said: "Here we turn for guidance, not to science but to the beating of our own hearts and to those great books of poetry, philosophy, and religion in which the finest of men have recorded what life could give in its highest, and happiest and most vivid moments. The sixth book of Plato's Republic, the thirteenth chapter of St. Paul's first letter to the people of Corinth, the Sermon preached by Jesus on the Mount—such brief communications as these are a better training-ground for those who would direct the affairs of nations than all the voluminous writings of Einstein, a Pavlov, or a Freud"?

In this problem of values, as McDougall has pointed out, we face the question not only and not so much of the "how" but of the "why" and "to what end." Evaluation involves purpose and direction; and it is there that the persistent question is being asked.

> ''O, I wad like to ken,'' to the beggarwife says I
> ''The reason o' the cause an' the wherefore o' the why
> Wi' mony anither riddle brings the tear into my e'e.''
> ''It's gey an' easy speirin,'' says the beggarwife to me.

The questions will up, and the human heart demands an answer. The answer is not easy. "It's gey an' easy speirin." The scientist has been concerned with the "how." He has confined himself to it. He has achieved great success in it. But he is beginning to realize that, somehow, the "how" and the "why" are inextricably bound up together, and the answer to the one involves an answer to the other. Ends and means are tied up in the same bundle of life. If he can deal with means alone as a scientist he must deal with ends as a man; but he would wish to use his ability and technique as a scientist in the whole field, and not in a part. Here is the attitude of the younger men in the field. I quote from "Human Affairs." "Science is not a device for making self-filling fountain pens. Science unveils a new order of values; it demands another way of living. With its vast concept of being we may cast a new mould for the shaping of action. For there is an intrinsic beauty in the architecture of scientific thought, an intrinsic worth in acquiring its realistic type of thinking, a superb ethical discipline in the impersonal quality of its ends. To spread the scientific spirit in the community is a need of the first importance. We must infuse the neutrality of science into the partiality of human affairs. We must leaven the mentality of our age, still heavy with individualistic and archaic modes of thought, with the rationale of science. How else, if not by such an attitude, can the supremely urgent innovations so patiently contrived by the human sciences be made available?" And again, "We believe that the human race has only begun to unfold the infinite range of its possibilities."

There is no lack of confidence here. There is the ring of the optimism of youth, aware of the ground which has to be conquered. The nature of man requires the discipline which comes from the objectivity of science. The cravings of the human spirit have to be submitted to the corrective of the process of facing facts as they are or as they will yet be ascertained to be. Science provides a pattern of thought, to which if man would submit himself much of the shortsightedness and unwisdom of man and the structure of society which he has built up would disappear. These statements will command assent. And, if, further, the scientist, the moralist, the philosopher and the mystic can together search out the heights to which man is capable of climbing, the task of mapping out the path by which the toilsome and laborious ascent may be made is not beyond the power of science, in its wider sense, to perform.

In all this groping of science toward wider human contacts, what is the responsibility of those among us who are concerned with the education of young men and women, and with the validity of the means of education which lie to hand? Where does science now stand in the scheme of education for the needs of the world of our time and of the time of the generation that is to follow us? This is a question which has been in the background of my thinking as I have endeavored to paint the picture of the values of science as they appear to me in their changing form.

Two things impress themselves on me. The first is that the method and the attitude of science are indispensable for modern life and thought. No young men or women are equipped for life without that background, for they will live their lives in an atmosphere permeated with that outlook and that method. Without this equipment they are as passive spectators looking out on the active stream of life as it goes past, for they have not the technique to understand the significance of the processes of modern civilization. This is not to say that we are sound in all our procedure. The time has come, in my judgment, to question the value of the large amount of time which those who are not to be scientists spend in the laboratories of our modern universities. It is not improbable that more might be gained by observation of the method and the enthusiasm of the able teacher of science. But that method and that enthusiasm must in some measure be imparted to all who are to take their share in the work of our modern world.

The second consideration—and it is even more fundamental—is that this kind of education is not enough for our time. It is imperative that the young scientist should know something of the problems of the psychologist, the philosopher, the economist, the sociologist and the statesman. Not that he should be familiar with the details of those vast fields; that is not humanly possible. But it is possible, and it is necessary, that he familiarize himself with one of the realms of human relationships and feelings, in order that he may place his science in its setting for modern needs. The value and the influence of the man who works completely apart from, and without knowledge of, the deeper movements of mankind, grows less with the passing years; for he at least will play no part in that widening influence which science must exert on the solution of the problems which confront the human race. In this matter we are in grave danger. One contemplates with disquiet and apprehension the increasing stream of narrow specialists who issue from the institutions of learning into a world that is seeking for other counsel than they can give. We need the men who are imbued with the scientific spirit and who have access to the inner courts of the temple of the mind and the spirit of man. That kind of man must be cultivated in our halls of learning. Can it be that we are failing in our task?

We go forward in the faith that truth is universal, and that ever-widening areas will be mapped and explored. It is a small island from which we set out to chart that great sea. If science is to be our instrument, it must be capable of meeting heavy demands. For we will voyage into the infinite, beyond the last horizon.

'From this wave-washed mound
Unto the farthest flood-brim look with me;
Then reach on with thy thoughts till both be drowned;
Miles and miles distant though the last line be,
And though thy soul sail leagues and leagues beyond—
Still, leagues beyond those leagues there is more sea.'

OBITUARY

JAMES LAWRENCE KELLOGG

ON July 8, 1938, James L. Kellogg, professor emeritus of biology in Williams College, died at his home in Williamstown, Mass., after more than a year of serious illness. He was in his seventy-second year, having been born at Kewanee, Ill., on September 15, 1866. He received the B.S. degree from Olivet College (Mich.) in 1888, while Hermon C. Bumpus was professor of biology there, and this association was an important factor in his choice of biology as a profession. He went from Olivet to Johns Hopkins University, from which institution he received the degree of Ph.D. in 1892. The honorary degree of A.M. was conferred upon him by Williams College in 1900, when he had become a member of its faculty.

After receiving the doctor's degree at Johns Hopkins he was for seven years professor of biology in Olivet College (1892–99). From 1899 to 1903 he was assistant professor of biology at Williams College and from 1903 to 1934 he was professor of biology and head of the department there, in succession to Professor Samuel F. Clarke. In 1934, at his own request, he retired from active teaching and became professor emeritus.

During the long services of Professor Clarke, Williams College was noted for its excellent record in its undergraduate training of biologists. Into this Williams atmosphere and environment Dr. Kellogg, an outsider, came after his years at Olivet College, and it is eloquent testimony to his abilities as a teacher and his qualities as a man that he maintained the high reputation of the department of biology. On the 25th anniversary of his coming to Williams his former students united in a testimonial of their high regard for him in the presentation of a watch and a sum of money. From some of the many letters to the committee arranging the testimonial, I select the following expressions of esteem: "I do not know of any man to whom I feel that I owe more"; "I have a peculiar and lasting affection for Dr. Kellogg"; "No man of my day did more for me"; "He is by far the most inspiring teacher I have come in contact with." Similar testimony to his success as a teacher is contained in a letter from President Garfield in reply to Dr. Kellogg's request to retire from active service at the close of the academic year in 1934, a part of which I quote: "Permit me to say to you quite simply and directly that as a Williams man I appreciate sincerely the long and very excellent service that you have given to the College. I know with what affection you are regarded by a great host of those who studied under you, and you know of their affection for it has been manifested in many ways." The *Williams Alumni Review* for April, 1934, published a new photograph of Dr. Kellogg and a detailed story of his life, and commenting on his announced retirement after thirty-five years of service there, said: "Is it any wonder that such men as Samuel Fessenden Clarke, James Ingraham Peck and James Lawrence Kellogg captivated and held the life-long interest, with the love and affection, of hundreds of students! Is it any wonder that the older established sciences—astronomy, physics, chemistry—yielded in popularity to biology!"

He was first of all a teacher, and to this work he devoted most of his energies. His lectures were prepared with care and given with an enthusiasm and intensity that left a lasting impression on his hearers. This devotion to his students left him only the fag ends of his time for research, practically all of which was done during summer vacations. His research publications, while not numerous, are all marked by meticulous care in observation, illustration and description. His first important paper was on the "Morphology of Lamellibranch Mollusks," which was undertaken at the suggestion of Professor W. K. Brooks as a subject for his doctor's thesis. It was published in the *Bulletin* of the U. S. Fish Commission in 1892 and consists of some fifty pages of text and one hundred figures on the anatomy and histology of lamellibranchs, particular attention being given to the structure and phylogeny of the gills. This work determined the direction of all his further researches, which were devoted entirely to this group of mollusks.

In 1898 he was invited by Dr. Bumpus, then professor of biology at Brown University and a member of the Rhode Island State Fish Commission, to undertake a study of the life history of the common clam, together with the problem and possibilities of clam culture. This work was published in the Report of the Commissioners in 1899 and appeared in more extended form in the *Bulletin* of the U. S. Fish Commission for 1899. Again in the last-named series he published in 1904 a valuable paper on the conditions governing existence and growth of the soft clam (*Mya arenaria*). The possibility of utilizing large areas of tide flats for clam culture was emphasized in these and later publications. In 1901 he made a study of the clam and scallop industries of New York state and again in 1905 a study of the feeding habits and growth of the hard clam (*Venus mercenaria*), both of which were published in the *Bulletin* of the N. Y. State Museum for the years named. In 1905 he made a similar study of the marine food mollusks of Louisiana, which was published from the Gulf Biological Station of Cameron, La.

His recognized leadership in this field led to his being invited to prepare a book for the American Nature Series (Henry Holt and Co.) on "Shell-Fish Industries." This book of 360 pages and 67 figures was published in 1910. It is charmingly written and is clear, humorous, literary and withal genuinely scientific. Naturally the story of the oyster occupies most of the book, namely, twelve chapters out of twenty-two. Other chapters deal with clams, scallops and general topics, such as anatomy, development, physiology, sea farming, interrelations of organisms, adaptations and design, etc. His last and in many respects most valuable original scientific contribution was on the "Ciliary Mechanisms of Lamellibranchs" (*Jour. Morph.*, 26, 1915). This study was begun in 1898 and later was continued in visits to all coasts of the United States. In this summary of years of work he describes these ciliary mechanisms in thirty different species, and his figures are so beautifully drawn that the Wistar Institute chose some of them as models for its style book.

He was a broadly trained naturalist with artistic temperament and in all his work showed what might be called a "perfection complex," which necessarily led him to limit the field of his research work but to do as thoroughly as possible all that he undertook. In his study of the shellfish he said he had traveled almost every mile of our Atlantic coast from Nova Scotia to Louisiana. He was particularly skilful with hand and eye, an excellent dissector and draughtsman, and his handwriting was like perfect copperplate. He loved the great outdoors and was a skilled photographer and an excellent shot with pistol and rifle.

In social relations he was reserved almost to the point of shyness, and his modesty and sense of humor prevented his thinking of himself more highly than he ought to think. But he was generous in appreciation of others and he bound his friends to him with bonds of real affection.

In 1892 he married Ida M. Archambault, of Buchanan, Mich.; to them were born four daughters, all of whom survive him. A host of former students and friends mourn with them the loss of a delightful and unselfish companion and a noble personality.

EDWIN G. CONKLIN

DANIEL WEBSTER HERING

1850–1938

DANIEL WEBSTER HERING, professor emeritus of physics and senior member of the faculty at New York University, died at his home in New York City on the 24th of March, 1938, at the age of 88 years.

Born on the 23rd of March, 1850, near Smithburg, Maryland, which lies on the western slope of the Blue Ridge Mountains, Professor Hering commenced his higher education in 1869 at the Sheffield Scientific School of Yale College, where he earned his Ph.B. degree in 1873. In 1876, when President Gilman opened the Johns Hopkins University primarily as a school for graduate study, we find Daniel Webster Hering among the first twenty fellows appointed to that institution, where he enjoyed the intellectual atmosphere surrounding such productive scholars as Sylvester, Remsen, Rowland and Martin. His field of study in this newly formed institution was civil engineering; and, there being at that time no regular provision for granting a degree in civil engineering at Johns Hopkins, credit for his scholastic achievements was transcribed to Yale, where he was granted the degree of civil engineer with honors in 1879.

In the years 1880 to 1884 he was professor of mathematics in Western Maryland College at Westminster, and in the following year became professor of physics at the Western University of Pennsylvania—now the University of Pittsburgh.

In accepting a position in 1885 as professor of physics and applied mechanics at New York University, Professor Hering commenced an association with that institution which was unbroken for a period of fifty-three years; barring a brief period of one semester at Western Maryland College, where he substituted for a professor who had gone overseas during the world war. While associated with New York University, Professor Hering was active as head of the department of physics until 1916, when he was retired. During the years 1902 to 1915 he was dean of the graduate faculty. From 1926 until his death he was curator of a very rare and valuable collection of some 1,800 clocks and watches donated to New York University by the late Mr. James Arthur.

In addition to these academic responsibilities, Dr. Hering was distinguished by the honorary degree of doctor of laws from the University of Pittsburgh in 1907; and again from New York University in 1917; in 1895 the Western Maryland College had conferred upon him the doctorate of philosophy. He became an honorary member of the Society of Phi Beta Kappa in 1887; was a fellow of the New York Academy of Science; and an early member, and later a fellow, of the American Physical Society.

In physics, as in other sciences, there are some who make important discoveries along the frontier of the great unknown; there are others, quite as worthy although often less spectacular, who step into the newly conquered territory, clear up the debris of battle and make habitable the ground gained. Of this latter type was Dr. Hering. His mind was ever keen in picking out what, in physical discovery, was really important. His pen was quick to record and transmit to his fellow physicists the latest investigations performed in foreign countries in what was then "modern physics."

He was alert in acquiring the technique of the production of x-rays and wireless waves following their discovery in Europe in the late nineteenth century.

This intellectual keenness in grasping the importance of new results is to be observed again in Dr. Hering's method of teaching. When the great Cavendish Laboratory was opened at Cambridge University in 1874 the laboratory method of instruction in physics was well inaugurated. This example was followed by Johns Hopkins University, where Rowland converted the kitchen of an old residence into a laboratory. Dr. Hering, realizing the value of this innovation, established an instructional laboratory by partitioning off a part of his lecture room at New York University. His convictions in this method of instruction are expressed in an article written by him in 1893 entitled "Laboratory Instruction in Physics."

Beyond the realm of physics Dr. Hering found many joys and interests in life. First among these was, perhaps, the James Arthur collection of timepieces. With characteristic energy he examined minutely every clock and watch and then prepared a careful catalogue of the collection. His enthusiasm for this work and his scholarly study of timepieces is splendidly portrayed in his beautifully illustrated book, "The Lure of the Clock," published by the New York University Press in 1932. Another major interest of Dr. Hering was the history of the public attitude toward science. This is exemplified in his very entertaining volume entitled, "Foibles and Fallacies of Science," published in 1924; and again in his James Arthur Lecture, delivered at New York University on April 2, 1936, dealing with "The Time Concept and Time Sense Among Cultured and Uncultured Peoples."

One can not conclude a minute to the memory of Daniel Webster Hering without reference to that remarkable mental and physical energy of his which remained, unabated, to the day of his death. Although suffering from impaired hearing for many years, he maintained an extraordinary sense of humor in every personal contact and radiated cheerfulness and enthusiasm to all who were fortunate enough to know him.

In 1881, Dr. Hering married Mary Hollis Webster, of Baltimore. Following her greatly lamented death in 1930, Dr. Hering continued living with his two daughters, the Misses Doris and Hollis Webster Hering, who survive him.

William H. Crew

New York University

RECENT DEATHS

Commander Milton Updegraff, professor of mathematics of the United States Navy, retired, formerly on duty at the Naval Observatory, died on September 12 at the age of seventy-seven years.

Dr. Willis R. Gregg, chief of the United States Weather Bureau, died on September 14 at the age of fifty-eight years.

Dr. John Clement Heisler, emeritus professor of anatomy at the Medical School of the University of Pennsylvania, died on September 9 at the age of seventy-six years.

Dr. John Jennings Luck, for fifteen years professor of mathematics at the University of Virginia, died on September 15 at the age of fifty-five years.

Dr. John B. Wentz, associate professor of farm crops at the Iowa State College, died on August 24 at the age of forty-seven years.

Dr. Thomas C. Hebb, professor and head of the department of physics at the University of British Columbia, died on August 13 at the age of fifty-nine years. He had been connected with the university since 1916.

Mary Freyer Montgomery, San Francisco, assistant clinical professor of surgery at the Medical School of the University of California, died on August 30 at the age of thirty-eight years.

William Robb Barclay, consulting metallurgist of the Mond Nickel Company, Ltd., of London, known for his work on the technique of non-ferrous metallurgy, died on September 16 at the age of sixty-two years.

The death at the age of sixty-eight years is announced of Dean Reinhold Matsson, of Sweden, churchman and botanist.

SCIENTIFIC EVENTS

THE HERTY FOUNDATION LABORATORY

Industrial and Engineering Chemistry reports that the Pulp and Paper Laboratory of the Industrial Committee of Savannah, Inc., has become the "Herty Foundation Laboratory" under an act of the Georgia Legislature. The change took place last February. Up to that time the laboratory had been supported financially chiefly by the Chemical Foundation, Inc., and by contributions of the Industrial Committee of Savannah, supplemented by appropriations of the Georgia Legislature.

At the close of 1937 it became evident that the major part of these funds would not be available in future and that in the event that other support was not secured the laboratory faced possible closure. However, an emergency fund was raised by equipment manufacturers under the leadership of C. Stewart Lee, of the Pusey and Jones Corporation of Wilmington, Del. Following this action, the Georgia Legislature made an appropriation of $20,000 at its special session, this being in addition to the $10,000 appropriated in the preceding regular session. These funds, with the continued contribution by the Industrial Committee of Savannah, ensured the financing of the laboratory for the current year.

The Georgia Legislature, looking to the future, created by special act the Herty Foundation, authorized to take over the equipment and operation of the laboratory and to receive contributions from other states and subdivisions thereof, individuals and corporations. The board of trustees of the foundation is made up as follows: Jas. Fowler, *chairman;* G. M. Bazemore, *vice-chairman;* Elliott W. Reed, *secretary-treasurer;* Harley Langdale; and G. E. Maddox.

It was determined to continue the past policies and purposes of the laboratory, making the information developed available to all and to cooperate with all agencies engaged in this field of work centered on systematic research to determine, with the use of standard paper-mill equipment and chemicals, what modifications are necessary to employ the fast-growing woods of the southern states for pulpwood and products manufactured therefrom.

At a meeting of the Board of Trustees of the Herty Foundation on August 6, at Lakeland, Fla., it was voted to carry out the work of the laboratory, according to the plans and intentions of the late Dr. Herty. Supervision of the business of the foundation will be in the hands of the chairman of the Board of Trustees and the secretary-treasurer. Charles Carpenter, assistant director of the laboratory since January, 1938, will continue in charge of the experimental operations.

THE FIVE-THOUSAND-YEAR TIME CAPSULE OF THE WESTINGHOUSE ELECTRIC COMPANY

THE Westinghouse Electric Company has made public letters that were placed in the 5,000-year time capsule to be deposited by the company on September 23 at the site of the New York World's Fair.

Dr. Einstein's letter, written in German, sums up his impression of the modern age in 161 words. The authorized English translation follows:

> Our time is rich in inventive minds, the inventions of which could facilitate our lives considerably. We are crossing the seas by power and utilize power also in order to relieve humanity from all tiring muscular work. We have learned to fly and we are able to send messages and news without any difficulty over the entire world through electric waves.
>
> However, the production and distribution of commodities is entirely unorganized, so that everybody must live in fear of being eliminated from the economic cycle, in this way suffering for the want of everything. Furthermore, people living in different countries kill each other at irregular time intervals, so that also for this reason any one who thinks about the future must live in fear and terror. This is due to the fact that the intelligence and character of the masses are incomparably lower than the intelligence and character of the few who produce something valuable for the community.
>
> *I trust that posterity will read these statements with a feeling of proud and justified superiority.*

Dr. Millikan wrote:

> At this moment, August 22, 1938, the principles of representative ballot government, such as are represented by the governments of Anglo-Saxon, French and Scandinavian countries, are in deadly conflict with the principles of despotism, which up to two centuries ago had controlled the destiny of man throughout practically the whole of recorded history. If the national, scientific, progressive principles win out in this struggle there is a possibility of a warless, golden age ahead of mankind. If the reactionary principles of despotism triumph now and in the future, the future history of mankind will repeat the sad story of war and oppression as in the past.

THE FEDERAL HEALTH PROGRAM AND THE AMERICAN MEDICAL ASSOCIATION

THE House of Delegates of the American Medical Association met in emergency session on September 17 with one hundred and seventy-five members in attendance. The meeting was called for consideration of the proposed Federal medical care program which was submitted at the National Health Conference in Washington in July and which requires an expenditure of $850,000,000 a year. The President's committee urged establishment of a Federal department of health, the secretary of which would be a member of the Cabinet. To this the association agreed, with the proviso that the secretary "must be a physician."

The report, adopted unanimously by the delegates, according to *The New York Times,* read in part:

> We approve the principles of hospital service insurance which is being widely adopted throughout the country. We particularly recommend it as a community project. Experience in the operation of hospital service insurance or group hospitalization plans has demonstrated that these plans should confine themselves to provision of hospital facilities and should not include any type of medical care.
>
> We recognize that health needs and means to supply such needs vary throughout the United States. Health needs usually depend on local conditions and therefore are primarily local problems. We therefore encourage county or district medical societies, with the approval of their state medical societies, to develop appropriate means to meet their local requirements.
>
> In addition to insurance for hospitalization we believe it is practicable to develop cash indemnity insurance plans

> to cover the costs of emergency or prolonged illness. Agencies set up to provide such insurance should comply with state statutes and regulations to insure their soundness and financial responsibility, and should have approval of county and state medical societies.
>
> We are not willing to foster any system of compulsory health insurance. We are convinced that it is a complicated, bureaucratic system which has no place in a democratic state. It would undoubtedly set up a far-reaching tax system with great increase in the cost of government. That it would lend itself to political control and manipulation there is no doubt.
>
> We recognize the soundness of the principles of workmen's compensation laws and recommend the expansion of such legislation to provide for meeting the costs of illness sustained as a result of employment in industry.

In urging full use of existing hospital facilities rather than building additional ones, the delegates reported that the stability and efficiency of many existing church and voluntary hospitals could be assured by payment to them of the costs of the necessary hospitalization of the medically indigent.

Concerning appropriation of funds for the indigent, the delegates said:

> Since the indigent now constitute a large group in the population, we recognize that the necessity for state aid for medical care may arise in poorer communities and the Federal Government may need to provide funds when the state is unable to meet these emergencies.
>
> In the face of the vanishing support of philanthropy, the medical profession will welcome the appropriation of funds to provide care for the needy, providing first, that the public welfare administrative procedures are simplified and coordinated, and second, that the provision of medical services is arranged by responsible local public officials in cooperation with the local medical profession and its allied groups.
>
> We feel that in each state a system should be developed to meet the recommendation of the national health conference in conformity with its suggestion that: The rôle of the Federal Government should be principally that of giving financial and technical aid to the states in their development of sound programs through procedures largely of their own choice.

Seven physicians were appointed as a body to consult with Federal authorities on the national health program. They are: Dr. Irvin Abell, of Louisville, Ky., president of the association; Dr. Edward H. Cary, of Dallas, Texas; Dr. Walter E. Vest, of Huntington, W. Va.; Dr. Walter Donaldson, of Pittsburgh, Pa.; Dr. Fred Rankin, of Lexington, Ky.; Dr. Frederick Sondern, of New York City, and Dr. Henry A. Luce, of Detroit, Mich.

THE BRITISH AND AMERICAN ASSOCIATIONS

AT its Cambridge meeting (July 17–24) the British Association for the Advancement of Science took two actions which promise to have important effects upon its future activities and influence. The first relates to proposed reciprocal relationships between it and the American Association for the Advancement of Science; the second, to its obligations to society. It is doubtful whether decisions of equal importance have been taken previously by the British Association in the more than one hundred years since its organization.

For several years the question of possible closer cooperation between the British and American associations has been discussed informally without any definite conclusion having been reached. These discussions do not imply that there has been any lack of cordiality between the two associations. In fact, their organizations are similar and for 90 years since the founding of the American Association (British Association, founded in 1831; American Association, in 1848) the members of each association have been welcomed at the meetings of the other. British scientists have frequently attended meetings of the American Association, and American scientists in considerable numbers, especially in recent years, have attended meetings of the British Association. At the recent Cambridge meeting 62 scientists from the United States and 19 from Canada were registered, or a total of 91, out of a total registration just under 3,000.

Last June at the Ottawa meeting of the American Association a committee was appointed to confer with representatives of the British Association respecting possible closer relations between the two associations. The British representatives at the conferences, which were held just before the Cambridge meeting, were Lord Rayleigh, president for 1938; Professors F. T. Brooks and Allan Ferguson, general secretaries; Dr. O. J. R. Howarth, secretary, and Sir Richard Gregory, editor of *Nature*. The American representatives were George D. Birkhoff, president for 1937; Harold G. Moulton, vice-president and chairman of the Section on Social and Economic Sciences for 1936; Herbert E. Ives, vice-president and chairman of the Section on Physics for 1934, and F. R. Moulton, permanent secretary. The conferences of these committees led to the passing of two resolutions by the council and the general committee of the British Association. Upon the passing of similar resolutions by the American Association the proposed reciprocal arrangements between the two associations will go into effect.

Under the terms of the first resolution, each association will invite, on alternate years, a distinguished representative of the other association to deliver a principal address. The invited British scientist will deliver the principal address at the summer meeting of the American Association, and the invited American scientist will deliver an address second in rank only to the presidential address at the annual meeting of the British Association. Evidently only scientists of very high standing and capable of delivering excellent addresses will be invited. There will be no limitations on the subjects that may be chosen or on the manner of their treatment, but it is expected that the addresses will be of the general quality of the presidential addresses of the two associations. It will, of course, be gratifying if from time to time the subjects treated are of international interest. Whether or not such subjects are chosen, the visiting scientists will add to the attractions of the meetings, and the publicity given their addresses by the daily press will promote cordial international relationships. It is hoped that the plan will prove so successful that it will be expanded to include corresponding arrangements with similar scientific organizations in other countries.

Under the terms of the second resolution, each association will elect as honorary members the principal administrative officers of the other association. The honorary members will receive the announcements and programs of the association to which they are elected. For example, the honorary members elected by the American Association will receive the general programs of the meetings, and also the four issues of SCIENCE each year which contain the preliminary announcements and the reports of the two meetings. The purpose of this reciprocal arrangement is to familiarize the officers of each association with the work of the other. Although the British and American associations are generally similar, each has its special excellent points about which the other might well know. The American Association certainly has much to learn from the British about organizing excursions and social functions, and especially about making the delivery of presidential addresses dignified and impressive events.

The British Association took another step which may mark a turning point in its history. In order to facilitate investigations of the interrelations of science and society and to promote cordial international relations among scientists, the council and the general committee authorized the organization of a division of the British Association to consider these special fields. The work of the new division will be directed by a committee to be nominated by the council of the association and elected by its general committee. The division is given very broad powers, including that of holding meetings at any times and places. In this more formal way the British Association will undertake to do even more than the American Association is attempting to do through its "Science and Society Conferences" organized by the Section on the Social and Economic Sciences.

F. R. MOULTON,
Permanent Secretary, A.A.A.S.

SCIENTIFIC NOTES AND NEWS

DR. ALBERT CHARLES CHIBNALL, professor of biochemistry at the Imperial College of Science and Technology, University of London, will give the Hepsa Ely Silliman Memorial Lectures for the year 1938 at Yale University. The title of his lectures is "Protein Metabolism in the Plant." The lectures will be seven in number; on October 12, 14 and 17, they will deal with protein metabolism in seedlings; the fourth lecture on October 19 will deal with the synthesis of amino acids and amides in the plant. The concluding lectures on October 21, 24 and 28 will deal with the general subject of protein metabolism in leaves.

DR. RICHARD E. SCAMMON, distinguished service professor in the Graduate School of the University of Minnesota, will give on September 23 a lecture before the New York University Chapter of Sigma Xi on "The universalist tendency in seventeenth century science and medicine as exemplified by the activities of the versatile Dr. Petty."

PROFESSOR C. O. E. BERGSTRAND, professor of astronomy in the University of Uppsala, has been elected correspondent for the Section of Astronomy of the Paris Academy of Sciences, in succession to the late Professor L. Picart, professor of astronomy in the University of Bordeaux.

THE Bene Merenti silver medal of the Bavarian Academy of Sciences has been awarded to Professor C. F. van Oyen, of Utrecht.

AT the recent meeting of the British Medical Association the Sir Charles Hastings clinical prize was presented to Dr. J. W. McFeeters; the Stewart prize to Sir Patrick Laidlaw and, as already reported in SCIENCE, the Dawson Williams Memorial prize to Professor Leonard Parsons. The Katherine Bishop Harman prize for 1938 was awarded to Dr. B. S. Platt.

THE Dr. Jessie MacGregor prize in medical science of the Royal College of Physicians of Edinburgh has been awarded to Dr. Susanne Paterson for her work on the therapeutic uses of progesterone.

DR. TRUMAN L. KELLEY, of Harvard University, was elected president of the Psychometric Society at the annual meeting held at the Ohio State University on September 7 and 8. He succeeded Dr. J. P. Guilford, of the University of Nebraska, who gave the presidential address, which was entitled "A Study in Psychodynamics."

DR. HAROLD F. BLUM, who recently resigned as associate professor of physiology at the University of California Medical School to join the staff of the

Washington Biophysical Institute, has been elected a member of the Association des Physiologistes de langue française.

According to the *Museums Journal* the Museum Association of Great Britain at its annual meeting at Belfast elected the following officers and councilors: *President,* Viscount Bledisloe; *Honorary Treasurer,* D. A. Allan, Liverpool Public Museums; *Honorary Secretary,* D. W. Herdman, Art Gallery and Museum, Cheltenham; *Honorary Editor,* W. E. Swinton, British Museum (Natural History); *Councilors,* Charles Carter, Plymouth Museums and Art Galleries; Sydney L. Davison, Lady Lever Art Gallery, Port Sunlight; James Eggleton, Glasgow Art Galleries and Museums; E. I. Musgrave, Wakefield Museum and Art Gallery.

Harold L. Hazen, associate professor of electrical engineering, has been promoted to a professorship and has been made head of the department of electrical engineering at the Massachusetts Institute of Technology. Professor Hazen succeeds Professor Edward L. Moreland, whose appointment as dean of engineering was announced during the summer.

Dr. Willard E. Hotchkiss, formerly president of the Armour Institute of Technology, expert in industrial management, has been appointed Maurice Falk professor of social relations at the Carnegie Institute of Technology. Dr. Hotchkiss will organize the new program of social studies for engineering students, thus getting under way an educational project which has been planned for several years and which is made possible by a grant of $500,000 to the endowment fund from the Maurice and Laura Falk Foundation of Pittsburgh. This gift was announced in December, 1937.

Dr. Francis Owen Rice has resigned from the faculty of the Johns Hopkins University to become professor of chemistry and head of the department of chemistry of the Catholic University of America, Washington, D. C.

Dr. Walter Thomas, formerly professor of phytochemistry in the department of agricultural and biological chemistry of the Pennsylvania State College, has been named professor of plant nutrition in the department of horticulture.

Dr. Saunders MacLane has been appointed assistant professor of mathematics at Harvard University.

Roscoe D. Hughes, of the department of zoology at Columbia University, has been appointed associate in biology at the Medical College of Virginia.

Promotions made at the Medical College of the University of Virginia for the session 1938–39 are: Dr. Stuart Michaux, professor of gynecology; Dr. R. H. Courtney, professor of ophthalmology; Dr. R. Finley Gayle, professor of neuropsychiatry; Dr. Thomas W. Murrell, professor of dermatology and syphilology; Dr. Lee E. Sutton, Jr., professor of pediatrics; and Dr. William D. Suggs, assistant professor of gynecology. Dr. Wyndham B. Blanton resigned last session as professor of history of medicine and has been made associate professor of medicine. Dr. Joseph F. Geisinger has been appointed professor of clinical urology. In recognition of their many years of service to the institution, following their retirement on July 1, emeritus professors were appointed as follows: Dr. St. George T. Grinnan, pediatrics; Dr. Emory Hill, ophthalmology; Dr. E. P. McGavock, dermatology and syphilology; Dr. Charles R. Robins, gynecology, and Dr. Beverley R. Tucker, neuropsychiatry.

Dr. Gordon M. Shrum, professor of physics at the University of British Columbia, has been appointed head of the department.

Dr. F. L. Wells, formerly in charge of the Psychological Laboratory at the Boston Psychopathic Hospital, has been appointed psychologist to the department of hygiene of Harvard University. His office address is 13 Holyoke Street, Cambridge, Mass.

Ralph Russell has been appointed to the staff of the Division of Fishery Industries of the Bureau of Fisheries as associate fishery economist.

Dr. George F. Potter, for the past eighteen years head of the department of horticulture of the University of New Hampshire, will take charge of the laboratory of nurseries and experimental farms in connection with the government project at Bogalusa, La., on the growth and development of the tung oil industry.

Fraser MacCartney, student gardener from the New York Botanical Garden, will spend a year at the Royal Botanic Gardens, Kew. He is taking the place of P. A. Chandler, who will fill Mr. MacCartney's place in New York. This is the third exchange arranged under the auspices of the English-Speaking Union.

At its meeting on July 25, the National Advisory Cancer Council recommended the following grants-in-aid: Harrison S. Martland, City Hospital, Newark, N. J., $1,425 for the further study of osteogenic sarcoma in radioactive persons; $7,500 to the University of Chicago for researches in carcinoma of the stomach in the relation of hormones to ovarian cysts and a study of carcinogenic substances in cancerous and precancerous tissue; $1,000 to B. R. Nebel, New York State Agricultural Experiment Station, for the study of the action of phenanthrenes on plant tissue cells;

$3,452 to the University of Cincinnati for improvement in the diagnosis and treatment of cancer; $6,600 to the American College of Surgeons, Chicago, for a study of hospitals and clinics with reference to clinical cancer service; $4,200 to Dr. John J. Bittner, for a continuation of his studies on the relation of nursing to breast cancer in mice.

UNDER the direction of Edward P. Davis, topographical engineer of the U. S. Geological Survey, Glacier Park has been remapped. Prior to this summer no work had been done on the park since 1912. Twenty-five years later the National Park Service made several additions to the map of the U. S. Geological Survey. It is expected that the map will be available next year.

A SUB-OFFICE of the U. S. Geological Survey was recently established at Jackson, Mississippi, from which will be supervised the surface water investigational work conducted by the survey in cooperation with the state of Mississippi, as a result of cooperative funds provided by the last legislature. Edward B. Rice, associate engineer, will be in charge. He will be under the general supervision of the district office at Montgomery, Ala. A sub-office has also been established recently at Baton Rouge, La., resulting from cooperative surface water investigations started in that state. Ralph E. Marsh, assistant engineer, is in charge under the general supervision of the district office at Montgomery, Ala.

A SCIENTIFIC expedition left British Guiana on September 6 to collect specimens of the bird, animal and fresh-water fish life at the Roraima Plateau, on the British Guiana-Venezuela boundary. Members of the expedition include P. S. Peberdy, curator of the British Guiana Museum; A. Pinkus, representing the Michigan State Museum and the New York Botanical Garden, and T. Pain, curator of the Chelmsford and Essex Museum, England.

DISCUSSION

THE UNDERTOW

MOST of our elementary geological text-books contain definite statements regarding the existence and behavior of the undertow. It is described as a subaqueous, outward flowing current which is present when the wind blows perpendicularly on a lee shore. It is said to be caused by the piling up of the water as a result of the shoreward movement caused by the wind. This outward moving current is believed to have its movement modified at times so that it is slowed up or even temporarily reversed by each incoming wave, but its average movement is outward. It is generally regarded as being an important factor in the sorting and transportation of sediments on the underwater terrace.

However, some years ago Professor W. M. Davis[1] raised the question as to the actual existence of such a current and presented a rather complete argument to show that what had previously been regarded as the undertow was only the backwash of the waves which had been mistaken by more or less frightened swimmers for an outward moving current. He ended his article by asking skilled swimmers to send in accounts of their experiences with shore currents.

In the replies received some expressed a disbelief in the existence of dangerous outward flowing subaqueous currents; other experienced swimmers were just as certain that, at least along some shores, such currents are present and sent in detailed accounts of their experiences.[2] These replies were summed up in an article by Professor Davis[3] and there the matter was dropped for a time.

Recently Professor F. P. Shepard again brought up the question in an article, "Undertow, Rip Tide or Rip Current"[4] in which he expresses a disbelief in the undertow as generally understood but describes riverlike movements of the water perpendicular to the shoreline running outward at intervals from a lee shore. These currents reach the surface and are said to occur a few hundred yards apart along a shoreline on which the waves are breaking. For this type of water movement he proposes the term "rip current."

With the above in mind a study was undertaken the past summer for the purpose of determining the existence or non-existence of the undertow. While the investigations as conducted did not prove the existence of an undertow that might be dangerous to swimmers, yet if by the term "undertow" is meant a current below the water surface that moves outward approximately perpendicular to the shoreline then the investigations show very definitely the existence of such currents under certain conditions, and the inference is very strong that they may be swift and dangerous during storms.

Obviously, direct observation of the behavior of the movements of the water is very difficult on a large body of water when a heavy sea is running. Therefore it was decided to begin the study by giving attention to the behavior of small water bodies. The first observations were made in a small body of clear water on the South Canadian River bottom near Norman, Oklahoma. This pond was about 20 feet long, 6 or 8 feet wide and 10 inches deep with a quite uniform slope from the sides toward the center. A wind with an estimated velocity of 12 miles an hour was blowing lengthwise of it. Observation of the water movement was made by using ink and a medicine dropper. A little ink liberated near the bottom about two feet out from shore showed a very definite movement of the water to windward. A drop of ink on the surface indicated a relatively rapid movement of water to leeward. This upper layer of moving water was about an inch deep. Here, then, was shown at once a decided undertow. Further investigations showed that the surface of the water in the pond was moving to leeward and that the water underneath was moving to windward. This bottom movement of the water extended clear to the windward side, thus substantiating the statement which is sometimes made that on the windward side of a water body there is often a subaqueous current moving inshore.

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[1] SCIENCE, 61: 206–208, 1925.

[2] SCIENCE, 61: 444, 468, 1925.

[3] SCIENCE, 62: 30–33, 1925.

[4] SCIENCE, 84: 181–182, 1936.

Along the shores that were parallel to the direction of wind the water below the surface moved out toward the center for a few inches and then gradually turned with the main body of the windward moving water.

At the windward end of the pond the water surface was smooth, but the waves gradually increased to leeward until they were about 1¼ inches high and produced a miniature surf. Later observations made on some of the artificial lakes in the Wichita Mountain Game Preserve gave similar results. These lakes were several hundred feet across and 10 to 40 feet deep. It was not possible at the time to get out more than a few feet from shore, but it was found that in all cases observed where the wind was blowing on shore there was a current beneath the surface moving outward, and on the windward side there was always a subaqueous current toward the shore. The velocity of these currents was estimated to be between 6 and 15 inches per second. Their velocity varied with the wind and with the depth of the water; the greater depth giving the slower movement. These undercurrents were generally quite steady with very little pulsating movement except in the shallow water close to shore. Close to the bottom the rate of movement of the water was considerably decreased because of friction and very little pick-up of sediment occurred at these velocities. However, when the bottom was disturbed and some of the sediment put into suspension it moved readily with the current.

With the coming of the summer vacation the locality of the investigations was changed to the lakes of western Michigan. Here the first studies were in connection with some small temporary ponds on the Lake Michigan beach some distance south of the entrance to White Lake Harbor. The results were the same as those noted above with the added observation that the *returning subaqueous current* shows a very strong tendency to follow channels on the bottom of the pond. This study brought out very clearly the fact that the subsurface water is extremely sensitive to the forces acting on it and travels most readily where it meets with the least resistance. Consequently, when currents are present in a body of water the direction and velocity of their movements is very largely determined by the direction of the channels that may be present and the size and shape of their cross-section. Keeping this in mind is very helpful in studying currents in larger water bodies.

Following these studies on small ponds, investigations were made of subsurface currents on several lakes ranging in size from 4 to 16 square miles. On these lakes work could be carried out by wading and by using rowboats when winds prevailed of a velocity that would prevent work on Lake Michigan. The clearness of water in lakes of this region is such that by using colored liquids water movements can be easily observed to a depth of several feet.

The first study was made on White Lake along a shoreline that was straight except for a small bay about 50 feet wide that made an indentation of 30 feet. The wind, which had a fetch of about a mile, was blowing on shore with a velocity of 11 miles per hour. The lake bottom sloped outward about two feet per hundred. Observations along the straight shoreline outward for 50 feet showed no appreciable currents except a slight littoral drift in a few places. However, in the median line of the small bay in water 14 inches deep there was a distinct subsurface current outward with a velocity of about one foot per second.

The next observations were made in a bay-like enclosure formed by two old docks, as shown in Fig. 1. The slope of the bottom from the shore outward is 28 feet per mile. The water is so quiet that there is a considerable growth of weeds in the south and southeast part of the bay. The wind, which was from the southwest with a velocity of 14 miles per hour, caused waves that were sufficient to toss a small rowboat considerably. There are no weeds in the north side of the bay, and along the old lumber dock a clear channel exists that deepens gradually to the west from the shore outward. Observations near where the old dock joined the shore showed that within about 25 feet of the shore the water was moving shorewards. The waves here were partly waves of translation. Whatever outward movement that was present was so hidden in the general confusion of the waters that it was not possible to detect any continuity. Between 25 and 50 feet from shore the water deepened from one foot to three

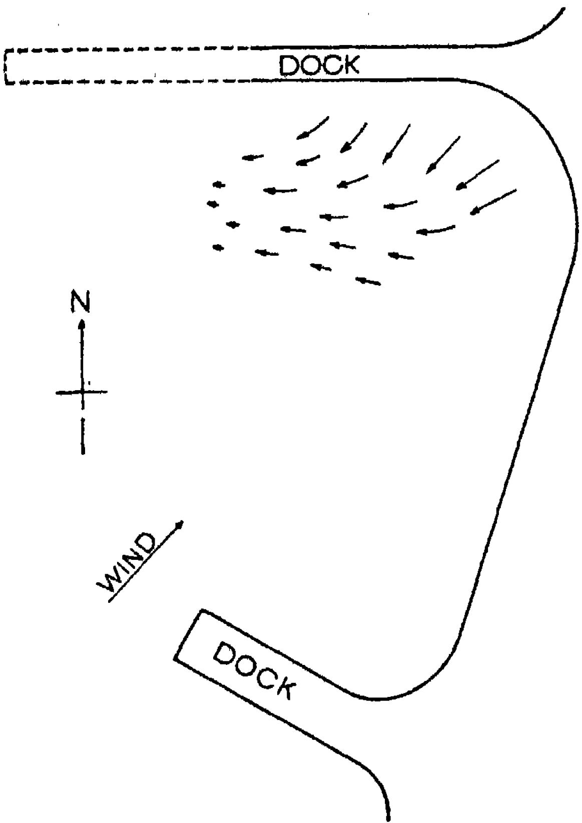

Fig. 1. The arrows show direction of subsurface currents.

feet. Here there was a steady definite outward moving undertow perpendicular to the shoreline with a velocity of one and a half to two feet per second. The wind was not entirely steady, and when the gusts held for two or three minutes the velocity of the undertow was increased considerably. About 50 feet from shore this subsurface current turned gradually and ran parallel with the old dock out toward the center of the lake. It was detected 75 to 100 feet further to the south but with decreasing intensity. As the current moved westward parallel with the dock it weakened as it came into deeper and deeper water until at a depth of six feet it had almost disappeared. It will be noted that this subsurface water was moving west, while the wind and waves were from the southwest.

Again on the northwest side of Silver Lake, which is circular in outline and about one and a half miles in diameter, a gentle southwest wind of five miles per hour gave waves about six inches high and five feet long. At 40 feet from shore in one and a half feet of water this caused a gentle but steady undertow.

Low ridges are frequently present on gently sloping under-water terraces on which there is a plentiful supply of sand. In the larger water bodies these ridges tend to be approximately parallel to the shoreline. They are probably built by the waves and currents during the heavier storms, but at other times they, themselves, exercise some control of the water movements. This was very noticeable on a part of Crystal Lake near Frankfort, Michigan. At Outlet Bay the underwater shelf extends out two thousand feet with a depth of only five feet at the outer edge. The bottom is of sand and gravel and the water is very clear. On this shelf are three sand ridges about one foot high and from 50 to 75 feet wide. The movement of the water on this shelf was carefully studied when the wind was blowing squarely into the bay from the north and the waves were about one and a half feet high. Between the beach and the first ridge, which was about 100 feet from the shore, no outward moving current could be detected, but there was some slight current at times parallel with the shore. However, on the offshore side of each ridge there was a definite but slow elliptical water movement as shown in Fig. 2. This was the general condition, although here and there a tendency toward a movement parallel to the ridges could be detected. So far as observed, the water movement over the ridges was toward shore but in some cases it was of an oscillating nature.

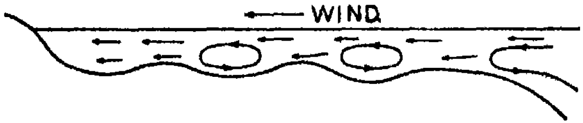

Fig. 2. Showing cross-section above the subaqueous terrace at Crystal Lake. Arrows show direction of currents.

The studies described above were made on relatively small bodies of water. However, it is quite probable that the movements of water in small lakes are similar to the movements that take place in the larger water bodies under similar conditions. One strong indication of this is the uniformly successful results that have come from the use of working models at the U. S. Waterways Experiment Station at Vicksburg, Mississippi. Therefore these studies would indicate that with favorable conditions of wind, shoreline and bottom contour an undertow does exist.

O. F. Evans

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FERTILITY AND INTELLIGENCE OF COLLEGE WOMEN

In a previous communication[1] it was reported that college men scoring high on intelligence tests at matriculation produce more children in the first dozen years after graduation than do those scoring low and that the differential which is significant in this result is age at marriage. It was desired to learn whether the same is true of college women.

The class of 1927 of the Women's (now Pembroke)

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[1] R. R. Willoughby, "Fertility and Intelligence of College Men," Science, 1938, 87, 86–7.

College of Brown University was selected for study; its members were tested in 1923 with the Brown University Psychological Examination. The scores of several could not be used because no information on their reproductive histories was available; they were not significantly different in intelligence from the remainder of the group.

The total group was divided at the median into a high-scoring and a low-scoring group of 54 subjects each; 36 live births had been reported for the former and 37 for the latter. Further subdivisions were made to correct for inequalities among the dates of latest reproductivity information, but no significant differences appeared beween the groups. A comparison of marriage dates also revealed no significant differences.

While these data are obviously inadequate, the tentative conclusion may be drawn from them that test intelligence is not a factor in the reproductive histories of college women, at least so far as the most fertile years are concerned. It is also incidentally evident that college women, like college men, fall considerably short of reproducing themselves. It is to be hoped that these conclusions and those of the inquiry previously referred to may be repeatedly examined as more data become available on the reproductive histories of the early test populations.

RAYMOND R. WILLOUGHBY

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THE ROLE OF THIAMIN IN ORGANIC EVOLUTION

IN connection with the article of Dr. R. R. Williams (SCIENCE, June 24, 1938), it may be of interest to point out that the assumption that thiamin is needed by all living cells, together with the statement that "only the higher plants can make it," would completely disrupt the concept of the evolution of higher from lower forms of life.

HUGO P. KORTSCHAK

EXPERIMENT STATION OF THE
HAWAIIAN PLANTERS' ASSOCIATION

DR. KORTSCHAK'S inference that my conception of the role of thiamin in the living world is at variance with the idea of the evolution of higher from lower forms of life is not one which I intended the reader to draw. On the contrary, I believe that our knowledge of the rôle of thiamin in living things has contributed a most important bit of chemical evidence that all forms of life have a common heritage. The single sentence which Dr. Kortschak quotes is taken from a brief paragraph in which I attempted to condense for the sake of perspective the results of some scores of experimental studies by various workers. It accordingly is lacking in accuracy of detail. Some, at least scanty, powers of synthesis of thiamin are doubtless to be found among the lower plants.

It does appear, on the basis of present evidence, that the higher plants are responsible for synthesizing most of the thiamin in living nature. However, it is not at all clear to what extent lower plants have failed to develop ample synthetic powers in this respect and to what extent past powers may have been lost through symbiotic or saprophytic habits.

R. R. WILLIAMS

BELL TELEPHONE LABORATORIES

SOCIETIES AND MEETINGS

AMERICAN GEOPHYSICAL UNION

THE *Transactions* of the nineteenth annual general assembly of the American Geophysical Union and the meetings of its seven sections, held from April 27 to 30, 1938, at Washington, D. C., and of regional meetings at Spokane, Wash., December 28 and 29, 1937, and at Davis, Calif., January 7 and 8, 1938, are now in press. Part I of 585 pages relates to the Washington meetings, and Part II of some 160 pages relates to the regional meetings.

Because of the importance of the minutes of the general assembly and of those of the sections, with their appendices, in the general view of the development of the union and of their interest to all its members, they have been included, for the first time, as a part of the *Transactions*. The total attendance of members and guests—534 at Washington—marks the character of the meetings in 1938 and the growing import of the union as a factor in the progress of geophysics in the United States. The attendance at the regional meetings also emphasizes this progress.

Included in the minutes are the reports of officers and of standing, special and research committees. Especially noteworthy are those of the newly formed planning and project committee and of the two committees on geophysical and geological study of oceanic basins and on geophysical and geological study of continents. These show the many problems calling for intensive theoretical research and potential possibilities of their applications in profound problems of earth physics.

The respective presidents, vice-presidents and secretaries of the union and its sections for three-year terms, July 1, 1938, to June 30, 1941, except as otherwise noted, are:

Union: R. M. Field; W. C. Lowdermilk; J. A. Fleming (1937–1940).

Geodesy: C. H. Swick; R. M. Wilson; W. D. Sutcliffe (1937–1940).
Seismology: J. B. Macelwane; H. E. McComb; F. Neumann (1936–1939).
Meteorology: R. H. Weightman; C. W. Thornthwaite; H. D. Harradon.
Terrestrial Magnetism and Electricity: E. O. Hulburt; E. A. Eckhardt; J. Wallace Joyce.
Oceanography: C. E. Iselin; G. F. McEwen; P. C. Whitney.
Volcanology: E. G. Zies; Adolph Knopf; James Gilluly.
Hydrology: L. K. Sherman; J. E. Church; K. H. Beij (all 1936–1939).

Four of the six resolutions adopted at the general assembly relate to magnetic survey of the land- and water-areas of the United States, geophysical survey of the Central Atlantic States, location of meteorological stations and meteorological research-projects. The other two resolutions express thanks for privileges extended at the Washington meetings by the Smithsonian Institution and the U. S. Geological Survey.

Preparations are well advanced for the seventh triennial assembly of the International Union of Geodesy and Geophysics, to be held in September, 1939, at Washington, D. C. During the nineteenth annual meeting of the American Geophysical Union, one evening was devoted to a smoker to discuss these preparations and to formulate further plans. This will be the first assembly of the International Union in the United States since its formation in 1919. It will afford opportunity to reciprocate the courtesies shown us at the six assemblies in Europe and to inform our foreign colleagues of the extent of geophysical research and interests in the United States. It is hoped especially that all the nations of South and North America will avail themselves of the opportunity to take active part in the Washington assembly.

The scientific session of the general assembly in 1938 was devoted to a symposium on the physics of volcanic processes. Five formal papers presented were: "Introductory—Applying Physics to Volcanoes," by Arthur L. Day; "Surface-Manifestations of Volcanic Activity," by E. G. Zies; "Structural Development of Volcanic Cones," by T. A. Jaggar; "Rock-Structures Associated with Some Ancient Volcanoes," by Chas. B. Hunt; "The Roots of Volcanoes," by Reginald A. Daly. Following a summary of the symposium by L. H. Adams, there was an extended and searching discussion.

In the Section of Geodesy 15 papers and reports were presented at two sessions. Five of these dealt with progress and development of geodetic operations and instruments in Canada, Central America, Mexico and the United States; seven related to gravimetric surveys, apparatus, interpretations and relation of gravity-anomalies and geologic structure; one each related to improvement of time-service and broadcasting, to sea-level datum and to the mathematical treatment of accidental and other errors.

The Section of Seismology held one session. The 12 communications may be classified as follows: Theoretical interpretations and analysis, 4; individual earthquakes and seismic measurements, 2; seismic instruments, 3; microseisms, 1; geophysical investigations of geologic structure, 1; progress-report for the United States, 1.

The Section of Meteorology heard six papers at one session. These concerned ultra-violet solar radiation (2), velocity of sound-waves (1), compilation of observations (1), expeditions (1) and meteorological aspects of radio-transmission phenomena (1).

Sixteen communications were presented at the session of the Section of Terrestrial Magnetism and Electricity. These related to instruments and technique (3), ionosphere and magnetic correlations (2), cosmic radiation (2), solar relations (1), fossil magnetization as determined from ocean-bottom core-samples (2), secular variation (1), auroral-zone currents (1), possible seismic and magnetic relations (1) and terrestrial electricity (3). The secretary submitted brief summaries of progress-reports dealing with magnetic and electric researches received from five organizations on work in Peru, Western Australia and the United States, including Alaska, Hawaii and Puerto Rico.

Ten papers before the meeting of the Section of Oceanography concerned progress during the year of four governmental and private organizations doing oceanographic work in the United States. One paper each related to the Gulf Stream System, deep-sea measurements without cables, chemical oceanography, an international program for collecting samples of ocean-water and methods of representing suboceanic relief on maps. A report from the International Commission on Continental and Oceanic Structure gave important features relating to an international program arranged for cooperative gravimetric work at sea.

At two sessions of the Section of Volcanology 12 papers dealing with igneous rocks and effects of temperature and pressure were read and discussed.

One of the important features of the nineteenth annual meeting was a joint meeting of the Sections of Meteorology and Oceanography. The 13 papers presented at the two sessions of this joint meeting were devoted to a symposium on atmospheric and oceanic circulation.

There were four sessions of the Section of Hydrology for the presentation of reports and papers. Twenty-four papers, with discussions, may be roughly grouped as follows: Rainfall, infiltration and groundwater, 15, and one appendix; stream-flow and flood-control, 6; and one each on evaporation, on glaciology and on contributions of the Water Resources Committee to hydrological investigations. The annual reports of permanent research committees were received and discussed as follows: (1) Snow; (2) glaciers; (3) evaporation from water-surfaces; (4) runoff; (5) physics of soil-moisture; (6) underground waters, with three appendices; (7) dynamics of streams; (8) chemistry of natural waters; (9) rainfall. Reports were also presented by newly formed special committees as follows: (1) Soil Conservation Service; (2) flood-waves, with six appendices; (3) density-currents. The total of 45 reports and papers affords evidence of the activity of the section.

The regional meetings of the Section of Hydrology at Spokane, Wash., and Davis, Calif., were arranged by special committees, of which W. A. Lamb and Morrough P. O'Brien were chairmen, respectively. Only three formal hydrological papers were presented before the North Continental Divide regional meeting at Spokane, the time being largely devoted to conferences and discussions; this meeting was held in affiliation with the Northwest Scientific Association.

The South Pacific Coast regional meeting at Davis, Calif., was held jointly with the Western Interstate Snow-Survey Conference. Sixteen formal hydrological papers were presented at three sessions, January 7 and 8, 1938. These related to hydrometeorology, precipitation and vegetation, evaporation, transpiration, forest and range hydrology (in relation to water-supply, forest management, live-stock industry and flood-control), floods, flood-control, evaporation and runoff from snow and studies in quality of irrigation-water. Nineteen reports and papers were presented and discussed at the Snow-Survey Conference on development of snow-surveying, methods of forecasting, economic aspects of snow-surveying, improvement of snow-survey equipment and winter sports. This meeting was concluded with a round-table conference and dinner.

The present *Transactions*, edited by the general secretary, include either in full or in abstract in Part I 140 papers and reports presented at Washington, and in Part II 38 papers and reports not elsewhere reported, with discussions presented during the regional meetings at Spokane and at Davis.

These *Transactions* afford further evidence of the scientific and economic value of geophysical research and of the contribution of the union through its coordination of many agencies. Further substantial progress may be confidently expected through the activities of the special committees of the union and of its sections, including the newly created planning and project committee.

JNO. A. FLEMING,
General Secretary

SPECIAL ARTICLES

THE SURVIVAL OF PLANT CELLS IMMERSED IN LIQUID AIR

A REVIEW of the literature[1] on the survival of plants or animals exposed to extremely low temperatures reveals that two kinds of organisms can support an immersion in liquid air (about −190° C.): (1) Those which resist a previous drying, *e.g.*, seeds, spores, protozoan cysts, tardigrades, nematodes; (2) those which do not exceed a few micra in size, *e.g.*, bacteria, yeast, monocellular algae, flagellates of the type trypanosome. This observation suggests that the survival might be due to the fact that water does not crystallize in these organisms, either because there is not enough water left in them to freeze, or because, on account of their small size and relatively large area, so much water can be withdrawn from them by osmosis during the congelation of their culture medium that they are practically desiccated. (The resistance to congelation offered by capillarity does not seem to be sufficient, alone, to explain the cold resistance of micro-organisms.) If, then, crystallization of water is the factor responsible for death by low temperature, all the cells in which formation of ice can be prevented should survive. In the research reported here, we intended to study if and to what extent protoplasm vitrified at low temperatures (as described in a previous work[2]) that is, protoplasm hard and breakable like glass, but in which water had not crystallized, keeps its vitality.

In the work just mentioned, it has been shown: (1) That gelatin gels containing 37 to 90 per cent. water can be brought into the vitreous state by a sudden immersion in liquid air; (2) that the thickness of the vitrifiable layer decreases with increasing water-content, extending from 0.3 mm to a few micra when the water content varies from 50 to 90 per cent.; (3) that the temperatures at which the material crystallizes cover a range of some 15 degrees only (from 0° to about −15° C.) and that crystallization takes place either during a cooling from the atmospheric to subzero temperatures or during a warming from the lower temperatures to above −15°; (4) that the possibility of obtaining the vitreous state depends primarily on the velocity of crystallization; pure water could not be vitrified on account of its excessively high crystallization velocity,[3] while gelatin gels are capable of vitrification in proportion to the slowness of their crystallization, that is, in proportion to their gelatin concentration.[4] The relation between the possibility of vitrification and the crystallization velocity is due to the fact that the vitrifying procedure consists essentially in cooling rapidly enough to bring the temperature of the material across the zone of crystallization temperatures (from 0° to −15°) before the ice crystals have time to form.

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[1] B. J. Luyet and P. M. Gehenio, *Biodynamica*, No. 33, 1938.

[2] B. J. Luyet, *Biodynamica*, No. 29, 1937.

This method of vitrification could be applied to entire plant leaves.[2] But preliminary experiments on the vitality of entire leaves gave results which suggested that some cells or tissues were alive, while some others were dead. We then investigated the tissues singly, beginning with the epidermis. This tissue can be obtained in monocellular layers thin enough for the extremely rapid cooling required, it stays alive a long time after being separated from the plant and it lends itself to several vitality tests. The present report is concerned only with investigations on the vitality of the epidermis.

Pieces of onion epidermis previously stained with neutral red and differentiated with potassium hydroxide—a procedure which allows the living and the dead cells to be distinguished by their color[5]—were mounted in small metal clips in such a way that each side of the tissue presented an exposed area of about 20 mm.^{2} The preparations were then immersed in liquid air. When removed therefrom and brought back, in air, to room temperature, the cells were all dead, as Becquerel, who made similar experiments on the same material, has also observed.[6] Comparing these results with those reported above on the vitrification of gelatin, we thought that the epidermal cells might behave as the gels containing 90 per cent. water which, to be vitrified, must either be reduced to a thickness of a few micra or lose some of their high water content. We then tried to dehydrate them by plasmolysis.

Stained pieces of epidermis immersed for about 15 seconds in a 5 per cent. solution of sodium chloride, were mounted as indicated above and, after removal, with a blotter, of the excess plasmolysing solution, they were immersed in liquid air. On being withdrawn from it, they were brought back, in air, to room temperature; the cells were all dead.

Assuming that death might have resulted from a congelation during the too slow warming of the material in the atmosphere after its exposure to liquid air and that warming in a liquid medium would be more rapid on account of the better heat conductivity afforded by the liquid contacts, we immersed the preparations in the plasmolysing solution after their treatment in liquid air. Several cells were now found intact and could be deplasmolysed or plasmolysed to a further extent, when put in a more concentrated solution of sodium chloride.

If, instead of a 5 per cent., we used a 10 or 15 per cent. plasmolysing solution, before and after immersion in liquid air, more of the cells were intact.

The fact that, to save the cells from disintegration, one must use the same means as for saving a gelatin gel from crystallization, that is, (1) dehydrate them, (2) cool them rapidly, (3) warm them rapidly; and the fact that the further the dehydration the more resistant are the cells to injury or the gels to crystallization, suggest that the same fundamental process takes place in the two cases, in other words, that disintegration of protoplasm subjected to extremely low temperatures is due to crystallization and that any method, such as vitrification, which prevents crystallization, prevents protoplasmic disorganization.

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INSULIN AND THE OXIDATION OF ETHYL ALCOHOL BY EXCISED DIABETIC LIVER TISSUE

A RECENT study in this laboratory of the action of insulin in increasing the rate of disappearance of alcohol from the blood has indicated that the acceleration of glucose oxidation by insulin catalyzes the oxidation of alcohol.[1] It seemed to us that conclusive information regarding this relation might be gained by a study of excised tissue from an animal completely deprived of its insulin supply by pancreatectomy. So far only liver has been extensively studied, since this tissue is probably responsible for the major portion of alcohol oxidation.[2, 3]

Cats were employed for this study because pancreatectomy in this species results in severe diabetes. The pancreas was removed aseptically under anesthesia; and the animals were given adequate food and laboratory care until the diabetes became maximal.

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[3] J. H. Walton and R. C. Judd, *Jour. Phys. Chem.*, 18: 722, 1914.

[4] E. H. Callow, *Proc. Roy. Soc. A.*, 108: 307, 1925.

[5] B. J. Luyet, SCIENCE, 85: 106, 1937.

[6] P. Becquerel, *Comptes rendus Ac. Sc.*, 204: 1267, 1937.

[1] B. B. Clark and R. W. Morrissey, *Am. Jour. Physiol.*, (Proc.), 123: 37, 1938.

[2] E. Lundsgaard, *Compt. rend. Trav. Lab. Carlsberg*, 22: 333, 1938.

[3] L. F. Leloir and J. M. Muñoz, *Biochem. Jour.*, 32: 299, 1938.

The animals were then sacrificed and 500 mgm of the excised liver tissue were suspended in 6 cc of saline phosphate pH 7.4 contained in glass-stoppered 125 cc Erlenmeyer flasks. Both the experimental flasks and control flasks containing killed tissue had identical quantities of alcohol approximating 2.5 mgm. All flasks were filled with oxygen and incubated for 3 hours at 37° C. with continuous agitation. After $ZnSO_4$ precipitation, the entire contents of the flask were subjected to steam distillation, and the alcohol in the distillate determined by Harger's method.[4]

Under the experimental conditions outlined, 19 observations on 8 cats disclosed that an average of 23.5 per cent. of the alcohol present was oxidized by normal cat liver tissue in 3 hours; individual experiments ranged from 16 to 39 per cent.

In marked contrast, 17 observations on liver tissue from 7 diabetic cats depancreatized for 72 to 96 hours revealed an average oxidation of only 3.1 per cent. with a range from -0.5 to 6.2 per cent. Since the maximal limit of error for the measurement of the alcohol under the conditions employed is 4 per cent., it seems probable that only very small amounts of alcohol were oxidized. The completeness of the diabetes was indicated by respiratory quotients slightly below 0.70 for excised kidney tissue from these animals.

Liver tissue from one cat depancreatized, but maintained on adequate insulin for 90 hours after pancreatectomy, revealed an oxidation of 36 per cent. This further indicates that insulin is the specific factor concerned.

Additional evidence was obtained in two experiments on animals that had been depancreatized 72 hours previously. A lobe of liver was removed under anesthesia, and then immediately afterward, 20 units of insulin were given to one cat and 14 units to the other. Approximately five hours later, the animals were sacrificed and another portion of liver tissue removed. The ability of the liver tissue from the same animal, with and without insulin, to oxidize alcohol was then compared. With the diabetic tissue there was practically no oxidation ($+0.3$ and -0.56 per cent.), but after the administration of insulin 29.4 and 27.5 per cent. of the alcohol present was oxidized.

While the oxidation of alcohol by normal cat brain is relatively small, preliminary experiments have suggested that oxidation by diabetic brain tissue is still less. We are now studying the effect of experimental diabetes on alcohol oxidation by the intact animal.

These experiments indicate that insulin is necessary for the oxidation of ethyl alcohol by cat liver tissue. It is not yet evident whether insulin acts specifically on the alcohol oxidation system or indirectly through carbohydrate metabolism. In a complete report to be published later, data concerning the mechanism of this action will be discussed.

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VITAMIN E AND AVIAN NEUROLYMPHOMATOSIS

BUTLER and Warren[1] have reported that vitamin E, supplied by injection or feeding of cold-pressed wheat germ oil, resulted in quick recovery from a paralysis which they indicated to be *neurolymphomatosis gallinarum*. They also claimed that adding wheat germ oil to the diet reduced the incidence of related diseases. Their statements are not supported by any definite figures, although their study "involved about 1,000 paralyzed birds."

Those who come in contact with the industry recognize the seriousness of avian neurolymphomatosis and the allied neoplastic conditions. Such methods of reducing mortality to the extent claimed by Butler and Warren would be well worth the expense of the added wheat germ oil.

The writer has investigated the curative effect of wheat germ oil in a study of 41 fowls showing clinical symptoms of fowl paralysis from the research flocks of this department. Ten of these birds were treated by intraperitoneal injection, 21 by feeding, and 10 birds served as non-treated controls. The source of vitamin E consisted of two lots of cold-pressed wheat germ oil, one of which had been lecithinized to reduce rancidity. These birds were, for the most part, White Leghorns of from 9 to 12 months of age. The procedure included recording (1) the symptoms and date of entry to the test and (2) gross lesions found during a complete routine autopsy. All hens were kept in flat-bottom battery cages with food and water easily accessible. They were not removed for autopsy until extremely emaciated or completely paralyzed for more than one day. The duration of the tests varied from 3 days, in extreme cases, to more than three months in less severe cases.

Ten fowls received wheat germ oil injected intraperitoneally, 1 cc per day, later reduced to 0.5 cc per day. Three of these received a total of 2 cc per bird, 3 got 3 cc each, 2 got 4 cc each, and the other two received 8 cc each of the wheat germ oil. Eight of these 10 birds showed at autopsy gross lesions of neurolymphomatosis involving the sciatic, brachial or abdominal nerves. The symptoms noted for one bird were "injury or paralysis of the right leg." This one improved and was returned to the laying pen. She was probably injured rather than paralyzed. Another fowl showed symptoms of unsteadiness on legs and jerking head movements. This bird apparently recovered, but one of the controls showing similar symptoms recovered without any treatment and hatched 33 out of 34 eggs in the past breeding season.

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[4] R. N. Harger, *Jour. Lab. and Clin. Med.*, 20: 746, 1935.

[1] W. J. Butler and D. M. Warren, *Jour. Amer. Vet. Med. Assoc.*, 92 (N. S. 45): 204–206, 1938.

Twenty-one hens were fed wheat germ oil, 14 receiving 6 cc or more, and of these fourteen, 8 received 14 cc or more. Of the 21 birds 14 showed at autopsy gross lesions of neurolymphomatosis, one showed lymphomatosis of the liver, another showed tumors of the feet, comb and internal organs. Two others, with typical symptoms, were negative. Of two birds with uncoordinated head movements, one improved and laid 29 eggs in the next 50 days. The other is still affected, showing no improvement.

Of the 10 controls 7 showed gross lesions of neurolymphomatosis on autopsy, one showed lymphomatosis of the liver and ovary, and one which had shown only uncoordinated head movements as symptoms was negative. One bird returned to laying condition for a brief period but eventually died. This hen never regained control of its paralyzed right leg. One bird (mentioned above) recovered completely.

Fowls showing uncoordinated head movements, twisting of neck to one side or over the back, generally eventually die of inanition. In some cases gross and microscopic lesions of neurolymphomatosis have been observed in the eighth or ninth cranial nerves of these birds. In other cases it is doubtful if the condition actually represents true neurolymphomatosis.

The evidence presented, involving 31 paralyzed fowls treated with cold-pressed wheat germ oil in amounts similar to or greater than those suggested by Butler and Warren, does not support their contention that vitamin E or wheat germ oil can bring about quick recovery from true *neurolymphomatosis gallinarum.*

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A PARADOX IN THE SCORING OF COMPETING TEAMS

LET us suppose that a number of teams of three men each are competing in an academic contest and that the best three teams are to be selected on the basis of a special examination. How shall the merits of the several teams be computed?

Two possible methods of scoring suggest themselves: (1) we may list all the contestants in order of rank, and define the rank of each team as the sum of the ranks of its members; or (2) we may consider only the actual examination-grade of each contestant, and define the score of each team as the sum of the scores of its members. The first method we may call the rank method, the second the sum-of-the-grades method.

The rank method is regularly used in scoring intercollegiate cross-country runs. It should be noted, however, that the situation in the case of the cross-country run is not the same as the situation in the case of the academic examination. In the athletic contest, the order of rank in which the men cross the finishing line supplies the only data available (since the individual times are not usually recorded), while in the academic case we have not only the rank of each contestant but also his actual examination-grade, on the basis, say, of 100. The sum-of-the-grades method is used in the popular frog-jumping contests. Here the score for each "team of three" (consisting, to be sure, of three jumps of a single frog) is computed by adding the lengths of the individual jumps recorded for that team.

In many practical cases it will make no difference which method is used. Nevertheless, the question has a certain theoretical interest which seems to be worth discussing.

The purpose of the present paper is to show that

TABLE I

I			II			III			IV			V			VI		
B_1	98	1	B_1	98	1	B_1	98	1	B_1	98	1	B_1	98	1	B_1	98	1
						D_1	97	2	D_1	97	2						
A_1	96	2	A_1	96	2	A_1	96	3	A_1	96	3	A_1	96	2	A_1	96	2
D_1	94	3				D_2	94	4									
C_1	93	4	C_1	93	3	C_1	93	5	C_1	93	4	C_1	93	3	C_1	93	3
A_2	92	5	A_2	92	4	A_2	92	6	A_2	92	5	A_2	92	4	A_2	92	4
D_2	91	6	D_1	91	5												
C_2	89	7	C_2	89	6	C_2	89	7	C_2	89	6	C_2	89	5	C_2	89	5
			D_2	88	7							D_1	88	6			
B_2	87	8	B_2	87	8	B_2	87	8	B_2	87	7	B_2	87	7	B_2	87	6
C_3	84	9	C_3	84	9	C_3	84	9	C_3	84	8	C_3	84	8	C_3	84	7
												D_2	83	9	D_1	83	8
B_3	82	10	B_3	82	10	B_3	82	10	B_3	82	9	B_3	82	10	B_3	82	9
									D_2	81	10				D_2	81	10
A_3	80	11	A_3	80	11	A_3	80	11	A_3	80	11	A_3	80	11	A_3	80	11
D_3	79	12	D_3	79	12	D_3	79	12	D_3	79	12	D_3	79	12	D_3	79	12
A	18		A	17		B	19		B	17		C	16		C	15	
B	19		C	18		A	20		C	18		A	17		B	16	
C	20		B	19		C	21		A	19		B	18		A	17	

the rank method, when applied to the academic case here considered, fails to satisfy the following postulate, which may be regarded by many people as a fundamental principle:

Postulate of relevancy. The relative position of any two teams—or the relative position of any three teams among themselves—ought to be determinable on the basis of the actual examination-grades obtained by the members of these teams alone. In other words, in determining the relative standing of any teams among themselves, it ought not to be necessary to take into account the performance of any contestants who do not belong to these teams.

To show that the rank method fails to satisfy this postulate, we construct the six following examples, each of which is a hypothetical, but entirely possible, case. There are four teams of three men each: "team A" has members A_1, A_2, A_3; "team B" has members B_1, B_2, B_3; and similarly for "team C" and "team D." The actual scores obtained by each of the twelve contestants, in each of the six cases I, II, III, IV, V, VI, and shown in the table; and the question is, how shall we determine the relative merits of teams A, B, C, in each of the six cases?

TABLE II

Case VII			Case VIII		
C_1	99	1	C_1	99	1
A_1	98	2			
			A_1	97	2
			B_1	95	3
B_1	94	3			
A_2	93	4			
			A_2	92	4
			D_1	91	5
			B_2	90	6
B_2	89	5			
D_1	88	6	D_2	88	7
C_2	87	7	C_2	87	8
			B_3	86	9
B_3	85	8			
D_2	84	9			
C_3	81	10	C_3	81	10
A_3	80	11			
			A_3	79	11
D_3	78	12	D_3	78	12
B	16		A	17	
A	17		B	18	

If we accept the postulate above, the relative standing of the teams A, B, C, whatever it may be, must obviously be the same in all six cases, since the actual grades obtained by the members of these teams do not vary from case to case. On the other hand, if we adopt the method of ranks, we see from the table that each of the six possible orders ABC, ACB, BAC, BCA, CAB, CBA, is represented by one of the six cases. The actual scores recorded in the six cases differ only in the scores obtained by two men, D_1 and D_2; and yet the variation in these two supposedly irrelevant items is enough to upset completely the order of merit among the three teams A, B, C.

No such ambiguity arises if the sum-of-the-grades method is employed. This method gives A 268, B 267, C 266, thus determining the order ABC.

As an even more striking illustration of the paradoxes which may result from the rank method, we construct two further examples, VII and VIII, as shown in the second table. Here there are four teams A, B, C, D, and the question raised concerns the order of the two teams A and B. In passing from case VII to case VIII every member of team B has improved his grade, while every member of team A has lowered his grade. Yet if the method of ranks is adopted, B starts out higher than A in case VII and then falls below A in case VIII. The change which has brought about this reversal of order is due entirely to changes in the grades of two men, D_1 and D_2, who do not belong to either of the teams A or B.

This paradoxical situation would not occur if the sum-of-the-grades method were used. According to this method we would have A 271 and B 268 in case VII, and B 271 and A 268 in case VIII, so that the change in the final order of merit in passing from case VII to case VIII would reflect in a natural manner the improvement in B's grade and the deterioration in A's grade.

These examples may suffice to show that if the postulate of relevancy is accepted, some method other than the method of ranks must be adopted.

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BECK, REGENA C. *Laboratory Manual of Hematologic Technic, Including Interpretations.* Pp. 389. 79 figures. Saunders. $4.00.

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THE LAND UTILIZATION PROGRAM IN THE SOUTHERN GREAT PLAINS[1]

By E. D. G. ROBERTS

CHIEF, LAND POLICY SECTION, SOUTHERN GREAT PLAINS REGION, BUREAU OF AGRICULTURAL ECONOMICS, U. S. DEPARTMENT OF AGRICULTURE

THE circumstances which have brought about the present distressing condition in which much of the Southern Great Plains region finds itself have, of late, received a great amount of publicity and are so well known that I shall content myself with presenting merely an outline of the chain of circumstances which have transformed some of the finest grazing land in the country into what is now being called the "dust bowl."

It has been said that the history of the Southern Great Plains region has been, for the past 60 years, a story of exploitation. A half century of over-grazing by some cattlemen was bad enough, but the damage they did was nothing compared to what happened during the 1920's. High wheat prices, favorable moisture conditions, and the introduction of farm machinery did the job. The residents were too busy making money to remember that earlier experiments in speculative dryland farming had not produced altogether happy results. The inevitable drought finally came, and with it came disaster.

The settlement of much of the Great Plains took place in accordance with a policy which was destined to place the largest portion of the area under private control as expeditiously as possible. The Federal Government, the state and territorial governments, the railroads and the multitude of speculators all desired to bring settlers into the country. The Homestead Laws have had a great deal to do with hasty settlement.

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[1] Address at the meeting of the Southwestern Division of the American Association for the Advancement of Science, Albuquerque, N. Mex., April 25, 1938.

They propagated the idea that 160 or 320, and later 640 acres of land were sufficient on which to make a living. They placed stress upon "improving" the land which, in this case, of course, meant to bring it into crops. Thus, it was attempted—and, in the beginning with a measure of success—to produce crops on land that was suited only for pasture. The farming methods and the climatical conditions were such that this procedure became extremely hazardous, and finally led to severe depletion of the land resources. The results were disastrous, from any angle one chooses to look at them. The system of agriculture which has been put into operation disregards entirely the natural conditions. A few seasons with plentiful moisture will not bring prosperity back. The problem goes much deeper than that. It is necessary to restore the balance which has been upset—a balance which was disturbed in but a few years and which it will take a long time to restore. Droughts, with their consequences of erosion, have left in their wake hundreds of thousands of acres of damaged and abandoned land, and have brought about wholesale impoverishment of farmers in certain sections of the region. Great areas depend for their very existence upon government subsidies, and the old-time stockman, and even the old-time farmer who lived on his own homestead has largely disappeared. Instead, we find a new type of migratory tenant farmer whose principal means of subsistence is derived from federal subsidies—the average expenditure of federal monies has been in excess of $300 for every man, woman and child in the 14 southwestern Kansas counties alone.

During the years between 1890 and 1895, when a severe drought prevailed in these areas, attention was temporarily directed toward more sensible land-use practices. It was then realized that in the Great Plains an agricultural economy, based solely upon cash crops, was hazardous, if not hopeless. These lessons were forgotten only too soon. At present, popular opinion has again swung toward recognition of the fact that most of these areas are not suitable for cash crop production, although this popular thinking is very often obscured by the influence of certain commercial interests which favor the type of program which would immediately bring the greatest amount of money to the towns. Some of them favor continued loans for the planting of wheat in the hope that with good moisture conditions bumper crops may again be harvested. The argument is heard that one good crop would make up for many failures; that conservation policies such as return to grass would accentuate emigration, etc. Unfortunately, these interests are in a position to make their viewpoints prevail, in the face of evidence which nature accumulates on their very doorsteps. The long-range effect of the type of program that they would favor is apparently lost sight of now, as it was in the nineties.

Conditions are, of course, very dissimilar from what they were in the late nineties. Most of the land is in private hands and a great deal of it is owned by absentee landlords (in some counties, almost half of it), whose main income is derived from other sources. Community patterns, with their governmental and civic organizations, have been set up, and a great deal of capital has been invested. Real estate companies and their agents have sold vast tracts of land to investors as far distant as the Atlantic seaboard. Towns have sprung up and multitudes of services have been established. Lately many of these services have been withdrawn, including school facilities, postal service and certain local business enterprises. For a while, the contentions of the various promoters seemed to be borne out by a combination of bountiful crops and good prices which were obtained during the war and post-war years. The population increased very rapidly and so did the area under cultivation. Then the weather cycle moved and several dry years followed, with the resulting catastrophic conditions which are, in some instances, beyond the power of description. Crops became complete failures, taxes, mortgages, etc., became delinquent, and the highways were crowded with farmers who drifted away as they had drifted in. Fiscal conditions, while extremely precarious, do not present a real picture, since the federal land bank and the insurance companies keep taxes paid on all lands on which they hold mortgages. The true effects of the situation are cushioned to a very great extent by governmental policies which have put a stream of federal monies, subsidies, grants and loans of every description into these areas. What would have happened without them is hard to say. But there is no doubt that emigration and abandonment of farmsteads and towns would have been accentuated and that human misery would have increased immensely. Some authorities, as a matter of fact, insist that the relief of human misery is the only justification for the millions expended in these areas; they state, with considerable evidence to back them up, that much of this money served only to encourage harmful practices and that, from a purely physical point of view, the country would have been better off if it had been permitted to find its own level. Increased abandonment would have left the fields to weeds and grass, and some sort of cover would have been restored. Instead of that, various types of subsidies financed such practices as breaking up the land year after year in a futile endeavor to raise wheat.

At present, there are wide areas unfit for agricultural pursuits of any kind, and it is doubtful whether some of them would revert to grass or even weeds without re-seeding and mechanical assistance, even under ideal conditions. Much more is now known about the soils of the region than was known a few years ago. The region as a whole contains approximately 100,000,000 acres, of which about one third have been put into cultivation. About twelve to thirteen million acres are deep, heavy High Plains soils, extending through sections of western Kansas, the Oklahoma Panhandle and the Plains of Texas. These soils are very fertile and of such a character that they respond readily to water-conserving and crop-management practices. In view of the extremely severe conditions that have prevailed, they have been only moderately affected by wind erosion. These soils could be brought under control by the use of contour tillage, summer fallowing or the use of proper crops, practices that would increase the rate of water penetration into the soil and would also distribute the moisture more equally. Even on such soils, farmers should take care that their economy is flexible enough to take care of the years when wheat crops would be a complete failure. Experiment stations have established the fact that it is folly to plant wheat when at the time of planting the soil moisture is less than 24 inches.

There are approximately six million acres of medium-depth sandy soils in the region. About 20 per cent. of these lands have been so seriously damaged that they will have to be retired from cultivation. If farmed properly, such soils are excellent for the production of row crops, but this type of land is extremely susceptible to wind erosion if not properly managed.

The third group of soils is the medium type, High Plains soil found in eastern Colorado and western Kansas. Such lands do not hold water well, and the run-off is very high. About four million acres of such soils are under cultivation now, most of them badly eroded. This land should be used for grazing purposes.

Finally, there are certain types of sandy soils which never, under any circumstances, should have been placed under cultivation. Some are too sandy for crop production and others are too shallow and have no capacity for water storage.

Thus, one of the primary tasks which confronts us is to retire some six million acres from crop production. There are considerable areas where mere retirement would be insufficient. Mechanical aid will have to be used to restore cover to these lands.

The Department of Agriculture has felt that a problem of such dimensions, which in its ultimate effects is bound to have wide repercussions upon the entire nation, could be properly handled only if the efforts of the department and its various agencies were combined and harmonized by a coordinator. A unity of program and the exchange of information among such agencies as the Soil Conservation Service, the Farm Security Administration, the Forest Service, the Bureau of Agricultural Economics and the AAA, is bound to facilitate this cooperation very greatly. Under this program other agencies, such as the Extension Service of the various state colleges and the various units of the Farm Credit Administration, are sending their representatives to planning meetings and conferences which already have brought about some very desirable results. Data have been secured by the research divisions of these many agencies pertaining to soil and land classification and to water resources. Economic and sociological surveys have been made by the former Land Use Planning Division of the Resettlement Administration, and innumerable maps, charts and data are available, giving detailed analyses of the land-use facilities, fiscal conditions and credit, school district and tax situations of the various counties of the Dust Bowl. Funds for the purchase of submarginal lands have been made available under Title III of the Bankhead-Jones Act. Under this program, the government purchases lands in the worst areas and retires them from use and, after cover is restored, permits them to be used by local grazing associations. Leases also will be granted to individuals, but governmental supervision will be retained. The Farm Security Administration, through its loans to farmers made contingent on a well-balanced farm plan, as well as upon sufficient soil moisture where loans are made for crop purposes, plays an extremely important rôle. This will be particularly the case when the long-term leases, which are designed to increase the size of units now too small to afford a living to a family, go into effect.

The machinery through which many of these adjustments are expected to be brought about is the Soil Conservation District, of which a number are being set up in the various states. It is the plan of the various agencies to fit their individual programs, with local cooperation, into the programs of these districts. The main obstacle will be overcome as soon as the public is educated to the ultimate benefits to be gained through cooperation. Through this democratic process, it is desired to make the program indigenous and adaptable to the area rather than have it imposed upon the population by Washington decree. Still, in some quarters, it is felt that real progress with respect to the necessary adjustments will be made only when either the local governmental units or the Federal Government will be in a position to control the land through ownership, lease or powers such as the Soil Conservation Districts exercise. Zoning laws, such as exist in Wisconsin, for example, are one approach which has proved effective. Although a great deal of further research is necessary, we have much of the technical knowledge necessary to rehabilitate the area, purely from a physical point of view. Great complications arise when we contemplate how to develop farm units which will insure the farmers of the area at least a living, even during the bad years. The farm management experts of the department are devoting a great deal of effort to the solution of this problem. The Soil Conservation Service and the Bureau of Agricultural Economics are both endeavoring to bring about the necessary mechanical and physical adjustments at a cost which can be borne by the farmers.

The Bureau of Agricultural Economics which, through its Land Utilization Program, administers the provisions authorized under Title III of the Bankhead-Jones Farm Tenant Act, maintains regional offices at Amarillo, Texas. The region comprises the states of New Mexico, Kansas and Colorado, and parts of Texas and Oklahoma. Its Land Economics staff is engaged in research work to study the long-range phases of the program. It also functions as a service organization to assist those staff members who are engaged in action programs. Studies carried on include land classification, soil reconnaissance, range studies, public finance and agricultural credit, flood control and underground and surface water studies. A staff of state planning specialists, with offices in each state of the region, assists in keeping in close touch with local programs and with the state colleges. The Farm Management staff of the bureau conducts intensive studies designed to enable the bureau to present recommendations for well-balanced farm plans. The Project Organization staff prepares plans and submits purchase projects; the Land Acquisition staff secures options and acquires the land. The Land Development staff is engaged in supervising the building of numerous dams and will have charge of the development work on the purchase projects; at present it is also engaged in development work on the old land use projects.

The Agricultural Adjustment Administration can eliminate a great many of the present difficulties by making its payments contingent upon the performance of soil-conserving practices.

The states and local governmental units have a responsibility in this matter which, so far, many of them have failed to meet. Many land owners would restore their land to grass if they were not discouraged from doing so by the tax situation which prevails. There should be a wide differentiation between the tax rates on regular crop land and on that which is more suitable for grazing land.

A more responsible ownership of land must be brought about if any improvement in land use is to be achieved. The present pattern of ownership is conducive to the worst kind of land use. The proportion of non-resident land ranges from 50 per cent. in some of the southwestern Kansas counties to as high as 83 per cent. in others. Land operated by non-resident owners is generally abused. The same applies, to a certain extent, to the tenant farmer who, because of his short lease, must plan his operations on a year-to-year basis, and is not, therefore, interested in a sound and efficient farming program. These are important factors causing the exploitation rather than the conservation of the soil. The Farm Tenancy Program is expected to play a very important part in the restoration of land ownership. Although only a small beginning is being made at present, it is considered a step in the right direction. The delineation of problem areas is proceeding. Such areas are being designated on the basis of soil reconnaissance, present land use, underwater facilities and fiscal conditions. Much of the research is carried on in cooperation with the local state colleges. A wise use of the credit opportunities provided by the Federal Government and other agencies will be important in restoring the land to a self-sustaining basis. With land purchases within the Soil Conservation Districts as nuclei, with agreements with states and large landholders, with demonstrations to farmers of what a well-designed land utilization program can do, it is hoped that effective adjustments will be brought about. That this will take considerable time is obvious, but it is hoped that the lessons learned will not be forgotten too soon, and that the demonstrations will prove effective in bringing about improved land use adjustments.

OBITUARY

OTTO HILGARD TITTMANN

OTTO HILGARD TITTMANN was born at Belleville, Ill., on August 20, 1850, and died at Leesburg, Va., on August 21, 1938. He was buried at the latter place on August 24.

He entered the service of the U. S. Coast Survey (later designated the U. S. Coast and Geodetic Survey) in 1867 and was assigned to field duty. As a result of his strict attention to the tasks assigned him he rose to the position of superintendent of the survey in 1900 and remained in this capacity until his resignation in 1915, after 48 years of service.

Among his important assignments were those of assistant astronomer with the expedition sent to Japan in 1874 to observe the transit of Venus; in charge of the Office of Standard Weights and Measures from 1887 to 1895; assistant in charge of the office from 1895 to 1899; assistant superintendent, 1899 to 1900; member of the Permanent Commission of the International Geodetic Association from 1901 to 1915; and delegate, representing the United States, to the meetings of that association in 1895, 1903, 1906, 1909 and 1912.

In addition to his duties with the Coast and Geodetic Survey, Dr. Tittmann took a leading part in the location, survey and monumentation of the boundaries between the United States and Canada and between Canada and Alaska. In 1903 he went to London, England, as a technical expert for duty in connection with the presentation of the case of the United States before the Alaska Boundary Tribunal. In 1908 he was appointed the sole commissioner for the United States, under the treaty of 1908, which clarified and amplified certain portions of previously executed treaties relating to the boundaries of this country, Canada and Alaska. He continued to serve as commissioner until his retirement in 1915.

Under Tittmann's supervision the greater part of all our northern boundaries was surveyed or resurveyed, adequately monumented and mapped. The technique for boundary surveying developed under his direction has become the model for boundary surveying and demarcation. He wisely demanded that the geographic positions of all boundary points should be determined by geodetic surveying methods, and that they should be firmly monumented or referenced. The splendid work on our boundaries inaugurated by Tittmann and his Canadian associate, W. F. King, has been continued by their successors. There are no other countries of the world having common boundaries that are so fortunate as our country and Canada in regard to their boundaries. The commissioners settle in an amicable manner any disputed points concerning the lines, and the citizens have no difficulty in knowing just where the boundaries are. Our northern boundaries are monuments to Tittmann's career of public service.

While he was superintendent of the Coast and Geodetic Survey, that organization made great progress in the development of instruments and methods for carrying on its engineering and scientific work, and in the interpretation of the data secured in the office and field. Among the noted accomplishments may be mentioned the following:

The adoption of the United States Standard Datum for the triangulation system of this country and incidentally also for the charts of the coasts and the maps of the interior. This datum was, in 1913, adopted also by Canada and Mexico, when, on account of its international character, it was designated the North American Datum. North America is the only continent that has a single system for its horizontal control surveys, charts and maps. This avoids the gaps, overlaps and offsets that exist in the maps and charts of the countries of other continents. Such confusion at times leads to controversies over the location of international boundaries.

The determination of the figure of the earth from geodetic measurements and data for the area of the United States. Its dimensions were accepted in 1924, as the most accurate ones, then existing, by the International Geodetic Association. This figure of the earth is still the international standard.

The proof of isostasy. Before Tittmann's administration of the Coast and Geodetic Survey isostasy was considered to be an unproved hypothesis. It is now recognized as a scientific principle, and is now given consideration by workers in the fields of theoretical and economic geology and geophysics.

The development of the theory of tides and the epoch-making reports on this subject by Rollin Harris, a mathematician of the Survey.

The development of the wire drag or sweep, by means of which many large boulders, pinnacle rocks and coral heads were discovered in our coastal waters. These objects had been menaces to navigation. They could not be readily found by the customary hydrographic methods.

The development of a precise levelling instrument that was free from the effects of troublesome systematic errors.

The completion of the Tide Prediction Machine, which made it possible to predict tides with great accuracy and with far less effort and time than had been required previously.

The inauguration of a comprehensive gravity survey, whose purpose is to furnish accurate values of gravity to those working in the physical and chemical sciences, and to those testing isostasy.

The inauguration of the use of invar tapes for the measurement of geodetic base lines.

The building and operation of five magnetic observatories as our part of a comprehensive international attack on some fundamental problems in the field of terrestrial magnetism.

Tittmann was thoroughly imbued with the scientific spirit and he imparted this to the members of the engineering and scientific staffs of the Survey.

As a recognition of his achievements he was awarded the degree of Sc.D. by Stevens Institute and Washington University and the degree of LL.D. by George Washington University. He was one of the original incorporators of the National Geographic Society and its president from 1915 to 1919; a member of the Philosophical Society of Washington and its president in 1899; a member of the Cosmos Club of Washington, D. C., and its president in 1904. He was also a member of the Washington Academy of Sciences, the American Society of Civil Engineers, the American Meteorological Society and the American Association for the Advancement of Science.

Dr. Tittmann was a gentleman in the best sense of that word, a public official of the highest character, whose sole object was to serve his country to the best of his ability, a delightful comrade and a true friend. Those who had the pleasure of knowing him will never forget his unselfishness, fairness and unfailing courtesy.

He is survived by his son, Major Charles Trowbridge Tittmann, of Washington, D. C. Dr. Tittmann's wife died at their home in Leesburg on February 14 of this year.

WILLIAM BOWIE

RECENT DEATHS AND MEMORIALS

DR. ALEXANDER FRASER, professor of pathological histology at the New York University College of Medicine from 1920 until his retirement in 1934, died on September 18 at the age of sixty-nine years.

DR. JAMES ERNEST BOYLE, professor of rural economy at Cornell University, died on September 18. He was sixty-four years old.

SIR ANDREW MACPHAIL, from 1907 until his retirement in 1937 professor of the history of medicine at McGill University, died on September 23 at the age of seventy-three years.

DR. SAMUEL ALEXANDER, honorary professor of philosophy in the University of Manchester, died on September 13 at the age of seventy-nine years.

Nature reports the death of M. de la Baume-Pluvinel, member of the section of astronomy of the Paris Academy of Sciences, on July 18, aged seventy-seven years, and of Sir Basil Mott, president in 1924 of the British Institution of Civil Engineers, on September 7, aged seventy-eight years.

THE *Journal* of the American Medical Association reports that during the recent Congrès des sociétés savantes, a plaque in commemoration of the work of the late Professor Brown-Séquard was placed in the lobby of the Central University at Nice. Before Brown-Séquard's election as professor of experimental and comparative pathology in the University of Paris, he had been professor of the pathology of the nervous system at Harvard University and was subsequently a member of the attending staff of the Paralyzed and Epileptic Hospital in London.

SCIENTIFIC EVENTS

SECTIONAL ISSUANCE OF BIOLOGICAL ABSTRACTS

A NEW plan for the publication of *Biological Abstracts*, beginning with 1939, has been adopted by the Board of Trustees. It provides for continuation of the monthly issues covering the literature of all the life sciences with increasing completeness and promptness at a uniform price of $25 to libraries and individual subscribers, alike. In addition, specialized sections of each monthly issue of *Biological Abstracts* will be published separately so that those who do not feel the need for the complete publication may acquire at low cost the sections in which they are especially interested. The sections adopted as seeming to promise the greatest usefulness are the following:

Abstracts of General Biology to include General Biology, Biography-History, Bibliography, Evolution, Cytology, Genetics, Biometry and Ecology. $4.

Abstracts of Experimental Animal Biology to include Animal Physiology, Nutrition, Pharmacology, Pathology, Anatomy, Embryology and Animal Production. $9.

Abstracts of Microbiology and Parasitology to include Immunology, Bacteriology, Viruses, Parasitology, Protozoology and Helminthology. $5.

Abstracts of Plant Sciences to include Phytopathology, Plant Physiology, Plant Anatomy, Paleobotany, Systematic Botany, Agronomy, Horticulture, Forestry, Pharmacognosy and Pharmaceutical Botany. $6.

Abstracts of Animal Sciences to include Paleozoology, Parasitology, Protozoology and Helminthology, Systematic Zoology and Economic Entomology. $6.

Subscribers to any of these parts will receive the indexes to the whole of *Biological Abstracts*.

The subscription prices quoted above are for the United States. Subscription rates for other countries will be announced at an early date.

The extent of coverage must, of course, depend on the extent of support. With no national society treasury to draw upon, this must be so. To insure publication a minimum of 1,250 subscriptions to the complete edition and four times as many orders for section issues are required.

In order to facilitate the plans for 1939, subscription blanks will shortly be distributed throughout the membership of the societies composing the union as well as to libraries and institutions generally. It is hoped that as large a response as possible by November 1st may be recorded in the office of the Business Manager, *Biological Abstracts*, University of Pennsylvania, Philadelphia, Pennsylvania.

BOARD OF TRUSTEES,
Biological Abstracts

THE ALLAN HANCOCK FOUNDATION BUILDING FOR BIOLOGICAL RESEARCH

AT the University of Southern California ground has been broken for the new Allan Hancock Foundation building for biological research, the gift of Dr. Allan Hancock.

The building will be three stories and will contain over a hundred laboratories for scientific research in zoology, botany and related fields. Private quarters will be provided for independent study as well as for students and graduate workers. Included in the collections of the university are several thousand specimens gathered on the seven Hancock Pacific expeditions to equatorial waters and the Galapagos Islands. Extending six stories from the basement will be a series of steel stacks designed against fire and earthquake, to preserve these rare specimens.

There will be two auditoriums seating 450 and 150 persons each, radio broadcasting rooms connecting all buildings, x-ray rooms, machine and wood shops and special laboratories.

Four rooms from the former Hancock mansion, recently demolished, have been moved intact and incorporated in the new building; these will form the nucleus of music, reception, library and exhibition rooms. Done in marble and carved woodwork by artisans of Europe, this portion of the building will serve the community as a cultural center for lectures and recitals, and for scientific demonstration purposes.

THE SQUIBB INSTITUTE FOR MEDICAL RESEARCH

AN attendance of a thousand scientific men is expected at the ceremonies dedicating to pure science the laboratory building which has been erected at a cost of $750,000, of the new Squibb Institute for Medical Research in New Brunswick, N. J., on Tuesday, October 11. Dr. George A. Harrop is director of the institute. The exercises will open with a reception at 12:30 P.M., followed by a luncheon meeting at 1 P.M., and will close with an inspection of the building from 3:30 to 5:30 P.M.

Professor August Krogh, director of the department of animal physiology at the University of Copenhagen, Denmark, and Dr. George R. Minot, professor of medicine at Harvard University and director of the Thorndike Laboratory of the Boston City Hospital, will be among those who will deliver addresses at the luncheon. Other speakers will be: Dr. Abraham Flexner, director of the Institute for Advanced Study, Princeton, N. J.; Dr. Russell Morse Wilder, professor of medicine in the Mayo Clinic, Rochester, Minn.; Carleton H. Palmer, president of E. R. Squibb and Sons, and Dr. John F. Anderson, vice-president and director of the Biological Laboratories of E. R. Squibb and Sons.

Dr. Krogh, Nobel laureate of 1920 for his work on the capillary regulation of blood supply in muscle, will discuss "Biology and Medicine in Cooperation." Dr. Minot, who shared the Nobel award in medicine in 1934 for his researches on the value of liver in the treatment of pernicious anemia, will speak on "Clinical Investigation," and Dr. Wilder will speak on "Industrial Laboratories and Clinical Research." The program will be concluded by Dr. Flexner, whose topic will be "The Usefulness of Useless Knowledge." The address of welcome will be given by Mr. Palmer, while Dr. Anderson will outline the aims of the institute as a pioneer undertaking of the pharmaceutical industry in promoting research in the medical and biological sciences. The speakers will be introduced by Dr. Harrop.

Sherley W. Morgan, professor of architecture at Princeton University, is architect of the building. It is U-shaped with a three-story main building flanked by side wings of two stories each. Usable floor space aggregates 52,000 square feet. Provision has been made for the immediate utilization of 100 rooms, seventy of which are individual laboratories and individual offices.

Construction is of steel, concrete and glass with complete insulation from outside weather conditions assured by walls fourteen inches thick, evacuated glass brick windows and air-conditioning equipment. The building rests on concrete footings reaching down to the Jersey red shale.

The institute will be in full operation this autumn. Research has been organized in four main divisions—experimental medicine, pharmacology, bacteriology and virus diseases and organic chemistry. In addition, the institute will operate a biochemical laboratory and a medicinal chemistry laboratory. The aim of the founders of the institute is to create in the medical and biological fields an industry-supported research enterprise analogous to the Bell Telephone and General Electric laboratories in the sphere of physics.

MEDICAL SYMPOSIA AT DUKE UNIVERSITY

THE first symposium in the series to be conducted in observance of the centennial year of Duke University will be held from October 13 to 15, and more than five hundred Southern physicians are expected to hear the twelve leading medical authorities who will appear on the program.

Attention during the three days will be focused on two problems, "The Future of American Medicine," to be discussed by Henry L. Mencken, contributing editor of the *Baltimore Sun*, and Dr. Morris Fishbein, editor of the *Journal* of the American Medical Association, and others, and "Diseases of Special Interest to Physicians in the Southern States," in a discussion of which a number of specialists will participate.

Three other symposia will be held during November, December and March. They will be on "The New Economic Base of the South," "The Law and Modern Society" and "Women and Contemporary Civilization." Foremost authorities in each field will be heard.

The symposium on medical problems will be the fifth annual symposium held at the School of Medicine. The first in the series was held in 1934 on orthopedics. During the next two years gastro-intestinal diseases and diseases of the heart, kidney and circulation were discussed. The symposium last year was on the diseases of women and children.

First speakers and their subjects for the forthcoming symposium will be: Dr. Allen Weir Freeman, dean of the School of Hygiene and Public Health, the Johns Hopkins University, "Public Health Development in the South," and Dr. George W. McCoy, of the School of Medicine of Louisiana State University, "Leprosy in the United States."

Three speakers will discuss "The Future of American Medicine" in the first evening session. They will be: Henry L. Mencken, of Baltimore; Dr. John Punnett Peters, professor of medicine, Yale University, and Dr. Morris Fishbein, editor of the *Journal* of the American Medical Association. Dr. Milton J. Rosenau, of the School of Medicine of the University of North Carolina, will preside.

The subsequent speakers on the symposium program will deal with more technical subjects of interest to Southern physicians. These speakers will be: Dr. George Hoyt Whipple, dean of the University of Rochester and a Nobel laureate, "Anemia and the Building of Hemoglobin in the Body"; Dr. William Henry Sebrell, surgeon in the U. S. Public Health Service, "Pellagra"; Dr. Charles F. Craig, of the Medical School of Tulane University, "Amebiasis"; Dr. Edward W. A. Ochsner, of the Medical School of Tulane University, "The Surgeon's Contribution to Treatment of Amebiasis"; Dr. William G. MacCallum, of the School of Medicine of the Johns Hopkins University, "Malaria"; Dr. Arturo Lorenzo Carrión, Columbia School of Tropical Medicine, Rio Piedras, Puerto Rico, "Rising Significance of Fungus Infections in Man," and Dr. Albert M. Snell, the Mayo Foundation, "Tropical and Non-Tropical Sprue: Their Probable Interrelationship."

INTERNATIONAL SOCIETY OF SUGAR CANE TECHNOLOGISTS

THE sixth congress of the International Society of Sugar Cane Technologists will be held in Louisiana, with headquarters at the Louisiana State University, Baton Rouge, from October 24 to November 5.

This society includes in its membership technical men interested in the production and manufacture of cane sugar. There are at present more than 725 members. The society holds triennial meetings alternating between the western and eastern hemispheres.

The delegates will assemble and register at the Roosevelt Hotel in New Orleans on October 24. During the first week, the delegates coming from outside Continental United States will be the guests of the State of Louisiana, the Louisiana State University and the American Sugar Cane League, and will be taken on a tour of the sugar-producing area of Louisiana.

During the second week, from October 31 to November 5, the sessions for the presentation of technical papers and for discussions will be held at the Louisiana State University, Baton Rouge. More than 130 papers have already been received by the secretary. These will be presented at sectional meetings. There are sections for pathology, entomology, cultivation, field technique, soils and chemistry and mill operations.

Delegates will be present from most of the sugar-producing tropical and sub-tropical countries, including Java, India, Australia, South Africa, Egypt, Hawaii, British and French West Indies, Puerto Rico, Cuba, Hawaii, Mexico and others.

The congress is being directed by a committee, with J. G. Lee, Jr., dean of the College of Agriculture, Louisiana State University, as chairman. The officers for the sixth congress are: *General Chairman,* E. W. Brandes, U. S. Department of Agriculture, Washington, D. C.; *General Vice-chairman,* P. Honig, Experiment Station of the Java Sugar Industry, Pasoeroean, Java; *General Secretary-Treasurer,* C. W. Edgerton, Louisiana State University, Baton Rouge, Louisiana.

SCIENTIFIC NOTES AND NEWS

KING LEOPOLD of Belgium has appointed, according to *Nature,* the first thirty members of the Royal Flemish Academy of Belgium. The academy comprises three classes: Sciences, Letters (including Political and Moral Sciences) and Fine Arts. A decree creating a Flemish Academy of Medicine may be expected to follow soon. This will form a complete equivalent of the old Académie Royale de Belgique, the official language of which is French. Further members will be coopted, the total number being confined to twenty per class. The members in the sciences are: J. De Smedt, A. Dumon, W. Robyns and G. Verriest, all of the University of Louvain; J. Gillis, J. Meuwissen, A. Schoep, H. L. Vanderlinden and A. J. J. Vandevelde, all of the University of Ghent, and H. Schouteden, director of the Congo Museum.

A DINNER was given in honor of Dr. Virgil Snyder, professor of mathematics emeritus at Cornell University, and Mrs. Snyder on Friday evening, September 9, at the Hotel Woodstock, New York City. The number attending was thirty-six. A silver bowl was presented on which is engraved: "Presented to Professor Virgil Snyder, Cornell University, by his Ph.D.'s as a token of appreciation," and also the names of the thirty-nine mathematicians who have written Ph.D. theses with Professor Snyder.

M. JEAN PERRIN, professor of physics in the University of Paris and a member of the council of the university, has been appointed by the French government president of the High Committee for Scientific Research. M. Perrin received the Nobel prize in physics in 1926.

DR. KARL VON AUWERS, professor of organic and physical chemistry at Marburg, celebrated his seventieth birthday on September 16.

DR. I. M. KOLTHOFF, professor of analytical chemistry and head of the department of chemistry at the University of Minnesota, on August 31 was made an officer of the Order of Oranje-Nassau by Queen Wilhelmina of Holland. This and other honors were bestowed by the Queen at her birthday celebration commemorating forty years as reigning monarch of the Dutch Empire.

THE King of Italy has conferred on Dr. J. C. Geiger, director of public health of the City and County of San Francisco, the Cross of Cavaliere of the Order of the Crown of Italy "for services of distinction in the field of public health."

DR. KARL WEGELIN, of Berne, Switzerland, who is a delegate to the International Pathological Congress in Washington, was guest of honor at a dinner of the Swiss Society of New York on September 20.

DRS. ERWIN JUNGHERR and Walter Landauer, of the Connecticut State College, have been awarded the Poultry Science Research Prize for 1938 of $100 for their paper entitled "A Condition Resembling Osteopetrosis (Marble Bone) in the Common Fowl," published in the *Bulletin* of the Agricultural Experiment Station.

THE honorary doctorate of laws will be conferred on Sir Walter Langdon Brown, emeritus professor of physics of the University of Cambridge, on the occasion of the centenary celebration of Dalhousie University, Halifax, Nova Scotia.

WILLIAM L. BATT, president of S. K. F. Industries, Inc., of Philadelphia, was elected president, to succeed Lord Leverhulme, of England, at the Washington meeting of the International Management Congress. He will preside at the meeting to be held in Stockholm in 1941. V. Lundvik, directing manager of the Swedish Industries, was elected deputy president of the international committee. The following vice-presidents were elected: L. H. Farasson, formerly president of the French committee for scientific management; Thomas R. Jones, president of American Type Founders Company, of Elizabeth, N. J.; Lord Leverhulme; Professor Th. Limperg, of the University of Amsterdam; Dr. F. Mauro, of Italy, first president of the committee, and George Seebauer, chairman of the German board of efficiency.

GEORGE E. ADAMS, associated with the Rhode Island College Experiment Station as student, horticulturist and in other capacities since 1891, dean of the College of Agriculture, director of extension and director of the station since 1933, retired on August 1. He is succeeded by Dr. Paul S. Burgess, dean of the College of Agriculture of the University of Arizona and director of the Experiment Station.

DR. H. S. WOLFE, who for the past six years has been horticulturist in charge of the Sub-Tropical Experiment Station of the University of Florida, has been appointed head of the department of horticulture in the college of agriculture of the university. Major W. L. Floyd has retired from this post after nearly thirty years of service.

DR. HIRAM S. LUKENS, who served as acting dean of the Towne Scientific School of the University of Pennsylvania after the death of Dr. Robert H. Fernald, was recently elected Blanchard professor of chemistry. He also is director of the department of chemistry and of the Harrison Laboratory of Chemistry.

DR. BERNARD J. ALPERS has been elected professor of neurology at Jefferson Medical College, Philadelphia, to succeed the late Dr. M. A. Burns. The appointment of Dr. Alpers, who has been connected with the University of Pennsylvania and the Pennsylvania Hospital, carries with it the establishment of a new laboratory of neurology at Jefferson Medical College. Dr. Henry K. Mohler has been appointed Sutherland M. Prevost professor of therapeutics, succeeding the late Dr. Ross V. Patterson, who also was his predecessor in the deanship.

DR. ROBERT SERBER, formerly research associate at the University of California at Berkeley, has been appointed assistant professor in the department of physics at the University of Illinois. Since the death of Dr. Kunz on July 18 Dr. P. Gerald Kruger has been acting head of the department.

DR. CLIFFORD WARREN CHAPMAN, of the Canada National Department of Health, has been appointed Emerson professor of pharmacology in the School of Pharmacy in the University of Maryland. He succeeds Dr. Marvin R. Thompson, who recently resigned to accept the directorship of the Warner Institute for Therapeutic Research.

DR. NORTON B. MOORE, of the Douglas Aircraft Company, has been appointed assistant professor of aerodynamics in the department of engineering of the University of California. Robert C. Uddenberg, of the

Boeing Aircraft Company at Seattle, has been made instructor.

Dr. Lester T. Earls, of Centenary College, has been appointed assistant professor of physics at the Iowa State College.

Dr. Joseph Albert LeSage, professor of clinical medicine of the faculty of medicine of the University of Montreal, has been appointed dean of the faculty to succeed Dr. Télesphore Parizeau, who has retired. Dr. Georges H. Baril, professor of physiological chemistry, has been made director of studies.

Dr. J. T. Irving, head of the department of physiology of the Rowett Research Institute of Aberdeen, has been appointed university lecturer in physiology at the University of Cambridge.

Dr. W. H. George, lecturer in physics at University College, Southampton, has been appointed head of the department of physics at Chelsea Polytechnic, in succession to Dr. L. Lownds, who is retiring after thirty-seven years' service.

Julian Glasser has joined the staff of Battelle Memorial Institute at Columbus, Ohio, and is engaged in chemical and electrochemical research in the field of metallurgy. Dr. Glasser has had industrial experience as electrochemist with the Utah Radio Products Company and as physical chemist with the General Electric Company.

Bernard Rackham has retired from the Victoria and Albert Museum, South Kensington, where for more than forty years he has been a member of the staff. He was associated with the department of ceramics, of which he has had charge since 1915, becoming keeper in 1921. He has been succeeded by W. B. Honey, who joined the staff of the department of ceramics in 1925.

Dr. T. H. Goodspeed, professor of botany at the University of California, is leading an expedition to the southern Andes to collect relatives of the tobacco plant and other forms. Dr. Goodspeed sailed from Naples on September 10, bound for Buenos Aires to take over the active direction of the expedition. In Buenos Aires he will meet two of his collectors, Walter J. Eyerdam, of Seattle, and Alan A. Beetle, of New Jersey. They will work southward from Buenos Aires through the Patagonian pampas to Tierra Del Fuego. After a stay there they will go through the Straits of Magellan and to the Chilean Lakes region, at which point they hope to arrive at the beginning of the collecting season. During his absence, Dr. Goodspeed, who is chairman of the University Committee on Cooperation with the Golden Gate Exposition, has been made a director of the exposition.

Dr. Z. I. Kertesz, research associate in chemistry at the New York State Agricultural Experiment Station at Geneva, has returned to the station following a year's leave of absence for special researches on enzymes at the Biochemical Institute in Stockholm under the auspices of the Rockefeller Foundation.

J. C. Miller, geologist in the Conservation Branch of the U. S. Geological Survey, has left for New Mexico to investigate carbon dioxide occurrences in Harding, Mora and San Miguel counties in that state.

Dr. Ora Smith, professor of vegetable crops at Cornell University, who has had leave of absence and a fellowship from the university for study and travel in Europe, has recently returned from a seven months' tour of eighteen European countries, where he made a study of research in biology being carried out by various institutions.

Dr. E. B. Renaud, director; Ted Sowers and Cecelia Evans, field assistants; Carol Cos, secretary and graduate assistant, and seven students, members of the third Denver-New Mexico Expedition, have reached Denver after having made a survey of the Indian petroglyphs found in North Central New Mexico. The area explored extended from Taos in the north to Albuquerque in the south; west of the Rio Grande it spread from Ojo Caliente to Jamez Springs, along the Chama Valley and over the Pajarito Plateau, while east of the river it covered the Galisteo Basin and neighboring districts, south of Santa Fe. Some twenty prehistoric sites were visited and studied and nearly 1,000 sketches and many photographs of Indian petroglyphs were taken. The results will be studied and classified by Dr. Renaud.

The autumn general meeting of the American Philosophical Society will be held on November 18 and 19, beginning at 10 A.M. on Friday, November 18. The society will provide hotel entertainment for non-resident members and invited guests if they will notify the executive officer as soon as possible of their intention to be present at the meeting. On Friday, November 18, the program will be under the auspices of *the Population Association of America*. A symposium on Population Problems will be presented, following which there will be a round table discussion; in the evening there will be a public lecture followed by a reception. A stated meeting of the council will be held on Friday afternoon at four o'clock, and on Saturday morning, November 19, there will be an executive session of the society. This will be followed by an open session at which recipients of grants from the Penrose Fund are invited to present reports of the progress or completion of their projects. Members of the society are invited to offer papers or to introduce non-members who have important papers to present.

DISCUSSION

LIGHT EYES AND GLARE SENSITIVITY

It has been noted that light-eyed persons can see less well under low illumination than dark-eyed persons.[1] It is also well known that albinos who lack retinal pigment see poorly not only in the daytime but also at night. They are particularly sensitive to bright illumination. One investigator[2] has found that Negroes see from two to four times better than whites at night. These findings would indicate that persons with dark eyes (Negroes representing the extreme) see better at night, whereas light-eyed persons (albinos representing the extreme) are less sensitive in darkness.

Another investigator reports that dark-eyed persons withstand dazzling glare better than blonds.[3] Our own results from testing 1,238 individuals also indicate that light-eyed persons are more sensitive to glare than dark-eyed persons. This may be explained by the fact that light pigmented eyes, being more transparent than eyes with dark irises, transmit more light.

In this experiment an attempt was made to distinguish eyes on the basis of darkness of iris pigmentation. All the light-grey-, blue- and green-eyed subjects were placed in one group, and the dark-brown- and blue-eyed subjects were placed in another group. We feel that the important factor is not the color but the lightness or darkness of the eyes.

Six hundred and twenty light-eyed individuals and 618 dark-eyed individuals were used as subjects. The apparatus used in this investigation was a glare sensitivity test[4] which simulates in miniature a night-driving scene. While the subject holds his head against the eyepiece, two glaring lights shine into his eyes. The intensity of light at the eyepiece is kept constant at all times. The subject during the test is required to distinguish the direction of stripes painted on a rotating test object which has its own source of illumination. The threshold of sensitivity is determined by increasing the illumination on the test object until the subject can distinguish correctly the direction of the lines. At this point the index of glare sensitivity is ascertained in terms of the amount of light required to correctly perceive the lines. Fig. 1 shows that light-eyed individuals in all age groups are more sensitive to glare than dark-eyed individuals.

We have found that light-eyed persons are under a double handicap, at night: (1) Their eyes are not as sensitive under low illumination as those of dark-eyed individuals, so they are not able to distinguish dim objects when driving alone on a road at night; (2) they are more sensitive to glare than dark-eyed individuals, so that when confronted by glaring headlights they see the road less clearly.

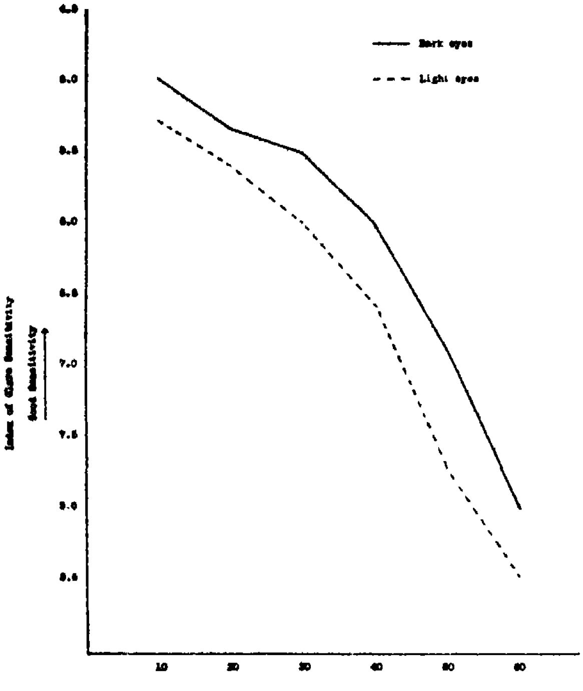

Fig. 1

There is also evidence that light-pigmented eyes have larger than average[5] pupils. Before acceptance, this discovery needs to be verified with more subjects. If found to be generally true, it may help to explain why light-eyed persons are blinded more by glaring headlights.

If future investigation corroborates the findings outlined above their applications to the automobile driver problem are as follows: (1) Light-eyed drivers as a group should be educated to drive more cautiously at night because of their poorer night vision and their greater susceptibility to glare from automobile headlights.

(2) Light-eyed drivers should be educated to protect their eyes by sun glasses in the daytime.

Harry R. DeSilva
Phillip Robinson

Harvard University

ON THE CITATION OF AUTHORITIES FOR BOTANICAL NAMES

Peattie has recently made a plea for botanists to take up again the one-man citation for scientific names, citing in the case of specific names the man who transferred the name into the proper genus, not the original authority. He also states that zoologists have picked the wrong man for their citations, since they cite *"the original authority, who first described the species."* It is urged that the one-man citation would make citing authorities less complex, thereby saving hours for those who use botanical nomenclature, but the important advantages of citing the original authority are mostly overlooked. In reality, Peattie has built an argument for scientific names with no authorities, which is entirely reasonable for popular, literary or horticultural usage, but botanists should not regulate their precise practices to these ends.

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[1] H. Helson and J. P. Guilford, *Jour. Gen. Psychol.*, 9: 58–76, 1933.

[2] J. N. Roy, *Arch. Ophthal.*, 48: 72–83, 1919.

[3] E. Bayer, *Indust. Psychotechn.*, 10: 207–209, 1933.

[4] For description of glare test see: "Driver Testing Results," monograph by H. R. DeSilva, *Harvard Traffic Bureau*, 1937.

[5] H. S. Langfeld, *Ztsch. f. Sinnesphysiol.*, 42: 349–358, 1907–1908.

The original authority is the most important authority because it is: (1) The one which stands for a type and an original description. Some workers seem to fail to appreciate the importance of the type-concept in systematic botany. (2) The one with which our knowledge of the species begins. From the citation of an original authority, it is immediately possible to gage the length of time that the organism has been known to science. (3) The one which best affords us some opportunity to estimate the validity of a species. By the citation of the original authority, a conservative worker's species, transferred to a small segregate genus by a "splitter," still remains recognizable, while in the one-man citation, as proposed by Peattie, the original authority is obscured.

That the double citation has great practical advantage is evidenced by an actual experience which I had on the morning when the copy of SCIENCE, with Peattie's article, arrived. I am soon to visit an herbarium in South Carolina and desire to know what types of an early author, representing species, recognized to-day, in certain families in which I am interested, may be expected to be found there. Reference to Small's "Manual of the Southeastern Flora," recognizing many segregate genera, but fortunately employing the double citation, revealed in 15 minutes all the information that I wanted to know. Had this manual followed Peattie's proposal, it would have been necessary to indulge in endless library investigation, looking up references by people who had transferred names, trying to determine from the old author's descriptions to what modern genera his species would have been transferred and then whether or not they are to-day valid. The slight inconvenience to the man who wrote this manual thus saved me hours of thankless drudgery, simply because he employed the double citation. It might be suggested that I could have obtained my information by reference to the writings of the original authority himself, but from them I would have no way of knowing which are recognized to-day, nor could I readily have obtained this information from Index Kewensis.

Let popular writers discard all authorities, but let systematists continue to follow their slowly evolved, meticulous practice. Authorities are not part of a name, but for accurate systematic work their careful citation becomes an absolute necessity.

ROBERT T. CLAUSEN

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BACTERIAL-PLANT GROUP OF DHAINCHA

THE names of the genus "Sesban," "Sesbana," "Sesbania," are synonymous.[1] The plant worked by me and published elsewhere,[2] *viz.*, *Sesbania aculeata* Poir, commonly called in India "Dhaincha," and the two species mentioned by Briscoe and Andrews,[3] *viz.*, *Sesban emerus* Aubl and *Sesban exaltata* (Raf.) Rydb., belong to the same genus "Sesbania."[4,5]

Briscoe and Andrews (*loc. cit.*) confirm the writer's earlier and more elaborate observations, save a few minor points. The writer, therefore, claims priority in its nomenclature as "Dhaincha Bacterial-plant Group" instead of that tentatively proposed by Briscoe and Andrews as "Sesban Inoculation Group."

Further work conducted by the writer on three other species of Sesbania, *S. speciosa*, Taub ex Ebgl.,[6] *S. grandiflora*, Poir,[1] and *S. macrocarpa*, Mohl ex Rafin,[1] indicate that they all belong to the "Dhaincha bacterial-plant group."

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SCIENTIFIC BOOKS

A BIOGRAPHY OF CLAUDE BERNARD

Claude Bernard, Physiologist. By J. M. D. OLMSTED, Professor of Physiology, University of California. Foreword by ALEXIS CARREL. Harper and Brothers, New York and London, 1938. xvi + 272 pp. $4.00.

CLAUDE BERNARD died on February 10, 1878. A few days later Michael Foster, then Trinity praelector in physiology at Cambridge, met his senior class and, putting his prepared lecture aside, remarked: "The recent death of a great physiologist, Claude Bernard, has determined me to spend the whole of to-day's lecture in pointing out to how large an extent the modern doctrines of physiology have been influenced by his brilliant investigations. It is not my purpose to dwell upon his personal history; indeed, there is happily but little to tell. Men of science are fortunate when their personal histories are uneventful; they live in their work and not in their lives." Foster's senior class then heard a masterful résumé of the scientific contributions of the great French physiologist. The Trinity praelector had evidently prepared his lecture with characteristic thoroughness, for he was prevailed upon to publish it a few weeks later in the *British Medical Journal* for April 13 and 20, 1878 (pp. 519–521; 559–560). As is well known, Foster published later (1899) an attractive "Life" of Bernard in "The Masters of Medicine Series." Neither of Foster's accounts, however, were biographies in the strict sense of the word; rather were they logs of his career as a scientist. Foster was interested in the background and development of his scientific ideas and his discoveries, but he made little attempt to portray Bernard as a man.

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[1] J. D. Hooker and B. D. Jackson, ''Index Kewensis Plantarum Phanerogamarum,'' Tommo II, p. 890, 1885.

[2] M. S. Raju, *Zentralblatt für Bakt.*, etc., II Abt., 94: 249–262, 1936.

[3] C. E. Briscoe and W. B. Andrews, *Jour. Am. Soc. Agron.*, 30: 135–138, 1938.

[4] A. W. Hill, ''Index Kewensis Plantarum Phanerogamarum,'' Supl. VI, pp. 193, 1916–1920.

[5] A. W. Hill, *Ibid.*, Supl. VII, pp. 228, 1921–1925.

[6] T. Duarand and B. D. Jackson, *Ibid.*, Supl. I, pp. 385, 1886–1895.

Professor Olmsted's "Biography," on the other hand, is far better rounded out, and is all that a biography should be; indeed it at once takes its place with the great personal biographies of our literature: Masson's "Milton," Festing Jones's "Samuel Butler," Paget's "Paré," Morley's "Cardan" and "Palissy," and with Cushing's "Osler." Olmsted's text is most attractively written and exhaustively documented, and the fifteen years he has spent collecting, sifting and digesting his sources are evident in every page of the book. The conscientious documentation affords one an opportunity to verify nearly every statement in the text, yet Dr. Olmsted has handled his citations so skilfully that they seldom catch the eye on the text page and one can read the book, as perhaps it should be read, as a novel. Certainly no medical student or teacher of physiology could arise from an hour's perusal of this fascinating record without being thrilled and inspired.

After the Foreword (which unfortunately repeats some of the half-truths about Bernard which Dr. Olmsted has tried to correct in his text), the book begins with a full account of Bernard's life (eight chapters). The details here given are drawn almost entirely from hitherto unpublished source material, and the account as a whole serves to correct the misimpression created by Foster that there was little of interest to tell about Bernard's personal history. The chapter begins appropriately with an authentic account of his birth and of the oft-repeated anecdote about his first literary production, the tragedy "Arthur de Bretagne," which, when presented to the Parisian critic Saint-Marc Girardin, was returned with the firm comment, "You have done some pharmacy, study medicine. You have not the temperament of a dramatist." Bernard forthwith matriculated at the School of Medicine in Paris. The rest of the story is well known to all physiologists. It was in the autumn of 1834 at the age of twenty-one that he entered the medical school. Save for anatomy, in which he excelled, he was not a good student; he devoted much of his spare time to anatomical dissection and while an interne at Hôtel Dieu his skill as a dissector became known to François Magendie, the founder of the French school of physiology. In 1843 Bernard became his *préparateur* at the Collège de France, which marked the beginning of Bernard's career as an experimental physiologist. He began by studying the effects of nerve section, spinal accessory, facial and vagus; his first published paper, which appeared in May, 1843, had to do with the chorda tympani—be it noted that this did not appear until he was thirty years of age. In the same year he undertook a new line of investigation and issued as a thesis for his medical degree a justly celebrated contribution entitled, "Du Suc gastrique et de son Rôle dans la Nutrition," which was the beginning of all that followed.

The second part of Professor Olmsted's biography is concerned with Bernard's contributions to the science of physiology. His early papers are described at some length and then came the themes so intimately associated with his name: pancreatic digestion, the glycogenic function of the liver, the vasomotor nerves, curare and other poisons, his collaboration with Pasteur, general physiology and, finally, his posthumously published notes on fermentation. The third part of Olmsted's biography is taken up with Bernard's speculative contributions, his tendencies as an eclectic and agnostic, his adherence to the principles of scientific determinism, and, finally, the broad concept of the stability of the internal environment of the body touched upon in many of his early works, but published in his two volumes, "Leçons sur les Phénomènes de la Vie," issued in 1878, the year of his death.

Bernard left his mark upon all phases of modern physiology, and no student of the subject can readily understand modern physiological thought without careful study of his writings. This illuminating biography also does much to elucidate the growth of physiology in the nineteenth century. It places Bernard's contributions in their proper perspective, and it paints a faithful portrait of Bernard as a human being—including his domestic misfortunes and his fascinating correspondence with Madame Raffalovich. The book has the external appearance of one of the lesser modern novels, but despite this lapse in taste on the part of the publisher, the book is equipped with an excellent biography and a general index, satisfactory for authors, but quite inadequate for subjects. It is understood that Professor Olmsted now intends to write a life of Magendie, and it is scarcely necessary to say that physiologists on both sides of the Atlantic will await his second biography with a sense of high anticipation.

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THE AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE

SYMPOSIUM ON MENTAL HEALTH

Preliminary Announcement

The Section on Medical Sciences of the American Association for the Advancement of Science announces a Symposium on Mental Health to be held in conjunction with the annual meeting of the association at Richmond, Va., from December 28 to 30, 1938, and cordially invites the attendance and participation of all interested persons.

A Cooperative Project

Collaborating in the plans for the event are the American Psychiatric Association (an affiliated body of the A. A. A. S.), the U. S. Public Health Service, the Mental Hospital Survey Committee (composed of representatives of eight national medical bodies),[1] the National Committee for Mental Hygiene and a special committee[2] of eminent psychiatrists who are developing the program for the symposium under the chairmanship of Dr. Walter L. Treadway, formerly assistant surgeon general of the Public Health Service.

Purpose of the Symposium

The symposium will provide an unusual opportunity to bring the great problem of mental health before the forum of the A. A. A. S. and, through it, to the scientific and lay public of America. It will be the tenth in the series of symposia held by the Section on Medical Sciences since 1934 and the first to deal with this important subject. All who have a serious interest in the subject will be welcome—scientists and laymen, professional workers and others—for the mental hygiene movement is a *public movement,* including among its adherents representatives from all walks of life and courting the good-will and support of all in its far-reaching aims and activities.

Its object will be, essentially, to present a synthesis of existing knowledge of the mental health problem, to evaluate past experience, crystallize aims and objectives and to marshall the scientific forces of the nation for a concerted, coordinated and more effective attack on mental disorders and disease. By drawing on the various scientific disciplines, within and without the field of mental hygiene, that are in a position to contribute new knowledge, we hope to light up the problem as never before and to arrive at a new and better orientation in dealing with it on its practical as well as theoretic side.

Plan and Method

The Symposium on Mental Health will be a three-day affair, with six sectional sessions, running consecutively, and with upwards of seventy scientific contributions. In addition, mental hygiene will be the topic of discussion at the final general session of the association's meeting, at which the symposium proceedings will be summarized. Headquarters for the symposium will be established at the Jefferson Hotel in Richmond, at which the administrative business of the symposium will be conducted during the conference period.[3] The special sessions of the symposium will be held in the auditorium of the Commonwealth Club; the general session at the Mosque.

The symposium will be, in some respects, a unique affair, in that most of the contributions will not be read at the meeting but will be published in advance, in a series of six brochures, one for each session, which will be used as a basis for discussion at the meeting. The various sessions of the symposium will be arranged and conducted under the leadership of section chairmen, who will summarize and critically analyze the individual contributions, which will then be formally and informally discussed by persons to be selected by them and to whom the brochures will have been sent for study well in advance of the meeting. In addition, there will be opportunity for general, open discussion at each session. All the discussions and summaries will be included, with the advance papers, in the published proceedings of the symposium, which will be issued and sold by the A. A. A. S. after the meeting.

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[1] American Medical Association, American Psychiatric Association, American Neurological Association, American Board of Psychiatry and Neurology, U. S. Public Health Service, National Committee for Mental Hygiene, Canadian Medical Association and National Committee for Mental Hygiene of Canada.

[2] Members of the committee, besides Dr. Treadway, are Dr. Clarence M. Hincks, general director, National Committee for Mental Hygiene, New York; Dr. Franklin G. Ebaugh, professor of psychiatry, University of Colorado, Denver; Dr. Roscoe Hall, clinical director, St. Elizabeth's Hospital, Washington, D. C.; Dr. Samuel W. Hamilton, director, Mental Hospital Survey Committee, New York; Dr. Grover Kempf, senior surgeon, Public Health Service, New York; Dr. Nolan D. C. Lewis, director, New York State Psychiatric Institute, New York; Dr. Abraham Myerson, director of research, Boston State Hospital; Dr. James S. Plant, director, Essex County Juvenile Clinic, Newark, N. J.; Dr. Harry Stack Sullivan, president, William Alanson White Psychiatric Foundation, New York; Dr. Joseph Zubin, assistant psychologist, Public Health Service, New York, and Dr. Malcolm H. Soule, director, Hygienic Laboratory, University of Michigan, Ann Arbor.

[3] Until then, correspondence in relation to the symposium should be addressed to the Administrative Office, Symposium on Mental Health, A. A. A. S., Room 822, 50 West 50th Street., New York City, Paul O. Komora, Administrative Secretary.

This plan of advance publication of a majority of the papers will make for the most effective use of the symposium technique, by providing the fullest time for free discussion and debate during the conference period. It will also insure a coordinated and integrated arrangement of the material to be presented, in that the various papers will be carefully edited, before use, to assure continuity, proportion and unity of thematic treatment. This procedure, by controlling the selection of topics and the areas to be covered, will tend to focus the discussions on basic issues and considerations of primary importance.

PROGRAM DEVELOPMENT

With this in view, the committee is constructing a special kind of program, having in mind the practical usefulness of the material in furthering the immediate and long-range objectives of the symposium, as well as its general scientific value. The program will thus be geared to the special purpose of the symposium, in which the whole field of mental hygiene will be staked out and the individual contributions fitted into a definite scheme and framework of discussion. It will present a wide range of data, covering all phases of mental health, but kept down, as far as possible, to fundamentals. The contributions will aim, on the one hand, to bring out what is definitely known in regard to a particular problem, and on the other, to expose for discussion and study questions and issues that are in the forefront of present-day scientific thinking in psychiatry and mental hygiene.

In formulating the program, the committee has adopted what it calls a "functional approach," in which the phenomena of mental disease and disorder are visualized, in the first place, as *intra-personal conditions,* that is, problems that arise within the individual; and, in the second place, as *inter-personal conditions,* in which environmental and social pressures o recognized as contributing factors in the produc-on of mental and emotional stresses.

In the first category consideration will be given to nown mental-disease entities of the functional organic variety, such as schizophrenia, the manic-essive psychoses, epilepsy, those associated with ural changes in the nervous system, with alco- syphilis and other endogenous and exogenous factors. In the second category attention will be centered on the geographical, physical and cultural environments conducive to mental health or ill-health, in which training and education, social and economic influences play significant rôles.

Half of the program will deal with problems of a medical nature that are the primary concern of the psychiatrist, neurologist, physiologist, biologist, biochemist and public health specialist; half will cut across non-medical fields and take in the sociologist, psychologist, anthropologist, economist, educator and political scientist. The latter will stress issues coming under the broad heading of "positive" mental hygiene and looking to the conservation and promotion of mental health.

TIME TABLE OF THE SYMPOSIUM

In line with this conception of program structure and function, the committee has made a careful canvass of the field, selecting contributors who will present the most authoritative and pertinent communications on the subject-matter to be covered by the various sessions. The topical material will be developed in sequence, one section leading logically to another, with an even flow of movement throughout the total symposium. The sectional headings and schedule of sessions are provisionally as follows:

Session I, Wednesday morning, December 28

Orientation and Methods in Psychiatric Research: Dr. Nolan D. C. Lewis, session chairman.

Introductory Address on Aims and Scope of Symposium: Dr. T. M. Rivers.

Session II, Wednesday afternoon, December 28

Sources of Mental Disorder and Disease, Their Amelioration and Prevention: Dr. Abraham Myerson, session chairman.

Session III, Thursday morning, December 29

The Economic Aspects of Mental Health: Dr. Joseph Zubin, session chairman.

Session IV, Thursday afternoon, December 29

Physical and Cultural Environment in Relation to the Conservation of Mental Health: Dr. Harry Stack Sullivan, session chairman.

Session V, Friday morning, December 30

Mental Health Administration: Dr. Clarence M. Hincks, session chairman.

Session VI, Friday afternoon, December 30

Professional and Technical Education in Relation to Mental Health: Dr. Franklin G. Ebaugh, session chairman.

General Session, Friday evening, December 30

Summary and Address: Dr. C. Macfie Campbell.

SCOPE OF SCIENTIFIC CONTRIBUTIONS: A PRE-VIEW

The first day will be devoted to a critical survey of concrete scientific problems in the domains of psychiatry, psychopathology and contributory fields, the sources and ramifications of mental disease and disorder, methods of investigation, diagnosis and treatment, and measures for the amelioration and prevention of mental disorders. The discussions will deal with the genetic and biological bases of mental disorders on the one hand, and the maladjustments between environment and biological functioning on the other. The philosophy of psychiatric research, the relationship of fundamental to applied research, the present status of psychiatric investigation and the rôle of academic and tax-supported research will be evaluated and discussed.

The second day will see the statisticians, economists and social scientists appraising the magnitude and scope of the mental health problem, its financial and human costs, the manifold social problems associated with mental disease, and its broad community and social aspects, in terms of environmental causes and conditions, their modification and control. The discussions will show, on the one hand, the enormous loss due to mental disease, in terms of curtailed earning power and of public taxation for institutional maintenance, and on the other, how economic factors contribute to mental breakdowns through maladjustments in the industrial and social order. They will assess the complex influences of modern civilization on human adjustment in terms of technological advancement, social lag, political and governmental factors, education and other social and cultural forces.

The third day will be focused on the practical aspects of the management and control of mental disease and disorders, public policy in the care and treatment of the mentally ill, the organization of mental health services and related matters. The discussions will concern themselves with the problem of developing more adequate measures and a wider and more equal distribution of facilities for the early recognition and treatment of mental ill-health, and the promotion of better public administration and of ways and means to implement mental health programs. Particular attention will be given to the pressing need for trained workers in the mental-hygiene field and the problem of developing a technical personnel adequate to the need.

MOTIVATION AND AIMS

The Symposium on Mental Health should be one of the most interesting and, if we consider the extent and character of the mental health problem, one of the most important conferences ever sponsored by the Section on Medical Sciences. It will be the first time in the history of the A. A. A. S. that this subject will have received special attention as a major topic on the agenda of its meetings. Mental diseases are among the most challenging of all medical problems, the most disabling and, in their personal, social and economic consequences, the most serious in the whole category of diseases. They occupy more hospital beds in this country than all others combined, yet they have been comparatively neglected, until relatively recently, so far as the general medical profession and the medical sciences are concerned. With the rapid advance of psychiatry and mental hygiene during the past few years, however, with their impressive achievements in research, therapy and prevention, mental disorders are receiving increasing recognition as a major problem of medicine worthy of serious attention and study by every medical discipline and offering great scientific promise.

Mindful as they are of its scientific value, those who are organizing the symposium rightly regard it, nevertheless, as something more than an opportunity for discussion and study. They look upon it as a stepping stone to practical accomplishment, as a vehicle for the larger objective, which is to secure fruitful, nationwide action toward the solution of the mental-disease problem in its immediate and remoter aspects. A glance at the present status of mental health administration in the United States will show that no community, no state or local jurisdiction has kept pace with the needs of the mentally ill. Rapid growths of population, coupled with the necessity for securing institutional provisions for the more urgent cases, have resulted in the development of piecemeal facilities and policies, without regard to an adequate and balanced program to meet these needs.

It is hoped that one result of the symposium will be an authoritative and comprehensive formulation of fundamental principles that may serve as a practical guide to state and local governments in developing sound, progressive and more uniform policies and measures in the care and treatment of the mentally ill.

It is hoped, further, that from the symposium will come a fresh approach and new points of view that may with advantage be brought to bear upon the whole problem of the cure, control and prevention of mental and nervous disorders. Dr. Treadway strikes the keynote of the symposium in the following epitome of its aims and purpose:

> It is high time that we mobilized all our scienti[illegible] sources and explored all promising approaches, in [illegible] to realize the potential contributions inherent in [illegible] various scientific disciplines, within and without the [illegible] of psychiatry. The Symposium, we feel, will illu[illegible] the mental health problem as never before and wi[illegible]

to a new and better orientation in dealing with mental diseases and disorders, both as to treatment and prevention, in their personal and more general aspects. Out of this undertaking, we hope, will come a publication of the highest scientific and practical value, one that will provide a secure base for future operations against this scourge of mankind, and will influence the development of mental hygiene for years to come.

MALCOLM H. SOULE,
Secretary, Section on Medical Sciences, American Association for the Advancement of Science

SPECIAL ARTICLES

RECOVERY OF EASTERN EQUINE ENCEPHALOMYELITIS VIRUS FROM BRAIN TISSUE OF HUMAN CASES OF ENCEPHALITIS IN MASSACHUSETTS

DURING late August and early September, 1938, there occurred an unprecedented outbreak of Eastern equine encephalomyelitis in southwestern Massachusetts. This was accompanied by cases of fatal encephalitis in children nearby. Fothergill, Dingle, Farber and Connerley[1] have just reported the isolation of Eastern equine virus from one of these fatal human cases, and our report confirms their results and describes positive findings in four additional cases.

Brain tissue from seven cases has been sent to us for study by Drs. Pope and Feemster, of the Massachusetts State Department of Health. Five of them yielded the Eastern equine virus as follows.

Brain tissue from each case received in sterile glycerine was triturated in a mortar and diluted in hormone broth to make a 10 per cent. suspension. 0.03 cc of the supernatant was injected intracerebrally into 3-weeks-old Swiss mice.

Forty-eight hours later most of the mice from four cases showed ruffled fur, slowing of activity, alternating with convulsive twitchings. They rapidly became prostrate with occasional accompanying convulsions and succumbed in 48 to 72 hours. Cultures from brain and organs proved sterile. Certain prostrate mice were sacrificed and their brains removed, prepared as above, and injected intracerebrally into further mice.

The mice receiving the second passage material became ill in 48 hours and died or were sacrificed within 72 hours. Further passages have given similar results.

Third and fourth passage brain suspensions were filtered through a Seitz pad and injected intracerebrally into mice. The animals succumbed promptly after 2 to 3 days, indicating that the transmissible agent was a virus of relatively small dimensions.

Similar material was titred intracerebrally in 30-day-old mice and subcutaneously and intraperitoneally in 12- to 16-day-old mice. All mice died through the 10^{-8} dilution. The high virulence of the agent in young mice by the subcutaneous and intraperitoneal routes is characteristic of the Eastern equine encephalomyelitis virus.[2] Moreover, the extremely short incubation period of 48 hours is likewise suggestive of the equine virus.

TABLE I

DIFFERENTIAL VIRULENCE (INTRACEREBRAL) IN LABORATORY ANIMALS OF VIRUSES ASSOCIATED WITH PRIMARY ENCEPHALOMYELITIS IN MAN

Virus	Rabbit	Guinea pig	Mouse	*M. rhesus* monkey	Young sheep
Rabies	++	++	++	++	++
Eastern equine encephalomyelitis	±	++	++*	++	++
Louping-ill	0	0	++	++	++
Japanese B encephalitis ..	0	0	++	++	++
St. Louis encephalitis	0	0	++	0–±	0
Poliomyelitis	0	0	0	+	0

* Virulent peripherally in high dilution for 16-day-old mice.

The virus was highly infectious for mice by the nasal route. Third passage mouse brain virus was fatal to monkeys and guinea pigs when injected intracerebrally in large doses. Temperatures rose to 105°

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[1] L. D. Fothergill, J. H. Dingle, S. Farber and M. L. Connerley, *New England Jour. Med.*, September 22, 1938.

[2] A. B. Sabin and P. K. Olitsky, *Proc. Soc. Exp. Biol. and Med.*, 38: 595, 1938.

TABLE II

NEUTRALIZATION OF MASSACHUSETTS VIRUS IN EASTERN EQUINE ENCEPHALOMYELITIS IMMUNE SERUM

Serum rabbit	Age of mouse and route of injection of serum-virus mixtures	Fate of mice injected with mixtures contai virus diluted as follows							No. M.L.D. protection
		10^{-2}	10^{-3}	10^{-4}	10^{-5}	10^{-6}	10^{-7}	10^{-8}	
Normal ..	4 weeks, intracerebral	....	2*,3,3,3,	2,2,3,4	2,3,4,4	3,3,4,4	3,3,3,4	3,4,S,S	
Immune ..	" " "	....	5,5,6,6	5,5,7,8	6,7,8,S	7,S,S,S	S,S,S,S	S,S,S,S	10^3
Normal ..	2 " intraperitoneal	2,2,3	2,3,3,	2,3,3	3,3,3	3,4,S	3,3,3	3,4,S	
Immune ..	" " "	S,S,S,	S,S,S,	S,S,S,	S,S,S,	S,S,S,	S,S,S,	S,S,S,	10^6+

* Day of death following injection.
S = Remained well.

at 24 hours and dropped to 104° or less after 48 hours. At 48 hours the animals appeared dazed, showed muscle weakness and then became prostrate, succumbing in 72 to 96 hours. Blood and spinal fluid taken at 48 hours contained virus. Brains from the animals removed just before or after death were free of bacteria and positive for virus. Rabbits similarly injected with the massive dose succumbed within 72 hours and their brain tissue injected intracerebrally into mice yielded virus after an irregular incubation period. Guinea pigs given virus in the pad developed a fatal encephalitis after 5 days. These reactions in animal species are different from those of other known viruses causing central nervous system virus infection in man and are characteristic of the equine strain (Table I).

Finally, specific neutralization tests were run on the four strains with hyperimmune equine encephalomyelitis rabbit sera kindly furnished by Dr. P. K. Olitsky. 0.3 cc of each brain emulsion dilution of virus was mixed with an equal quantity of undiluted immune serum and similarly with undiluted normal rabbit serum. The mixtures were shaken and then injected without delay intracerebrally into Swiss mice according to the standard technique, and in duplicate intraperitoneally into 16-day-old mice according to Dr. Olitsky's technique.[3] The immune sera showed a protective effect in the intracerebrally injected mice of at least 10^3 lethal doses and in the young mice of 10^6+ lethal doses (Table II), thus completing the identification of the unknown virus strains as Eastern equine encephalomyelitis. Western equine encephalomyelitis immune serum did not neutralize the virus.

This is the first instance in which the horse virus has been definitely implicated as causing encephalitis in man.

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THE PRODUCTION OF A GONADOTROPHIC SUBSTANCE (PROLAN) BY PLACENTAL CELLS IN TISSUE CULTURE

IT has been generally accepted that the placenta produces the anterior pituitary-like hormone (prolan) excreted in the urine during pregnancy. The weight of evidence supports such a theory, but there has been no direct proof. It seemed that the culture of placental cells *in vitro* might provide a method of demonstration. With this in view continuous culture of human placental tissue was undertaken.[1]

In the present investigations the specimens cultured were a placenta of three months, obtained by hysterotomy, and a hydatidiform mole. The mole specimen was sent us from the Boston Lying-In Hospital through the courtesy of Dr. Arthur Hertig. At the time of the first assays the placental tissue had been in culture for two months and the mole for nine days. The culture medium used was human cord serum 40 per cent., beef embryo extract 10 per cent., balanced salt solution 10 per cent., and chicken plasma 40 per cent. For microscopic observations some fragments were explanted into large lying drop preparations on No. 1 cover slips (40 × 45 mm). Most of the tissue fragments were explanted in the same medium in roller tubes. The roller tubes with added supernatant fluid were rotated at a constant speed of twelve revolutions per hour by the Gey[2] method. The supernatant fluid was changed every three and four days, and the cultures were patched and transferred as necessary.

In the mole cultures three morphologically different types of cells migrated from the explants: (1) large epithelial cells with clear cytoplasm and round delicate nucleus with several nucleoli. Some of the large cells showed as many as four nuclei and by their general appearance were considered as possibly the precursors of the syncytium. (2) Fairly large and densely granular cells. These occurred usually in closely packed masses with the single migrating cells in the medium showing many short processes and giving to them an asteroid or chestnut burr appearance. These cells had small delicate round nuclei. (3) Large spindle cells, usually vacuolated, with prominent slightly oval nuclei and with a single large nucleolus. These cells showed evidence of mitotic and of amitotic division.

The placental cultures showed chiefly the large vacuolated spindle cells, but with some transitional types to ones of epithelioid appearance. In these cultures the syncytium exhibited no growth. The myxomatous connective tissue grew very poorly and was soon outstripped by the growth of Langhans' cells. After about two weeks of cultivation in the roller tubes only cells of the Langhans' type were found. A cytological description of the cells and their cultural characteristics will appear in a later publication.

The production of prolan by the placental cells was tested by performing an Aschheim-Zondek test on 21-day-old rats with the cell free supernatant fluid which was removed after having been in contact with the living cultures for three days.

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[3] P. K. Olitsky and C. G. Harford, *Jour. Exp. Med.*, 68: 173, 1938.

[1] According to published reports placental tissue has been cultured by Heim, Neuweiler and Guggisberg, Friedheim, Sengupta and Taszkan but was not maintained longer than three weeks. In unpublished work done about the same time (G.O.G.—1927) hydatidiform mole was cultured for a period of sixteen days and human placenta for ninety-four days.

[2] G. O. Gey, *Am. Jour. Cancer*, 17: 752, 1933; G. O. Gey and Margaret K. Gey, *Am. Jour. Cancer*, 27: No. 1, May, 1936.

The first assay was performed on the combined fluid from the tissue cultures of the three-month placenta and the hydatidiform mole. There were five tubes of placental tissue containing approximately twenty fragments each and four tubes of hydatidiform mole containing about ten fragments each. The total amount of fluid injected was 4 ml; 0.6 ml was injected twice daily for three days. The rats were opened and the ovaries examined on the fifth day. The test was strongly positive for prolan, each ovary having several blood points. One ovary was fixed and examined microscopically in each assay. As controls 4 ml of human cord serum and 8 ml of beef embryo extract were injected separately into two rats. These substances were the main constituents of the nutritive medium used in the cultivation of the tissue. Both gave negative assays.

The following week, using the same technique, fluid was removed from the tissue cultures of both the three-month placenta and the hydatidiform mole and tested separately for prolan. 1.75 ml of fluid from the placental cultures proved positive for prolan. The fluid from the mole gave a positive Friedman test. As a control 1.75 ml of fluid removed from roller tube cultures of normal human muscle fibroblasts which had been growing in continuous culture for 20 months was used. This gave a negative reaction.

The next series of assays, using 1.5 ml of supernatant fluid from the three-month placenta, 1.25 ml of fluid from mole and 1.75 ml from normal human muscle fibroblasts were all negative for prolan. The fluid from the mole, however, produced several large follicles in each ovary and a swelling of the uterus. Microscopic examination of the ovaries showed an increase in the size of the interstitial cells. This series of assays was performed irregularly, two of the injections being given only three hours apart instead of the desired eight hours and the rats used, although chronologically 21 days old, were noted to be smaller than usual.

The assays were repeated at a later date, using 4 ml of fluid from the mole cultures, 2 ml from the placental cultures and 3.5 ml of fresh unincubated culture fluid as a control. The culture techniques had been slightly changed before this fluid was removed, and the fragments were not very active. The hydatidiform mole fluid again proved positive for prolan. The placenta and the control gave negative prolan reactions.

1.5 ml of fluid from a culture of cells of the anterior pituitary gland of an eight-month human foetus was also assayed for prolan. The ovaries of the test rat showed no blood points grossly. Microscopically some increase in the size of the interstitial cells and an apparent increase in the amount of interstitial tissue was noted. Although this could not be interpreted as a positive assay for prolan it suggested some hormonal activity.

In summary: (1) evidence is presented which shows that the placental cells produce a substance similar to the prolan-like substance found in the urine of pregnant women. (2) Placental cells growing in tissue culture for a period of over two months retain the ability to produce the hormone *in vitro*. (3) The cells responsible for this hormonal activity are possibly the Langhans' cells. (4) A hydatidiform mole growing in tissue culture for one month also produced the hormone. (5) The supernatant fluid bathing cultures of anterior pituitary cells of a human foetus gave negative prolan assays, but the microscopic appearance of the ovaries in the test rat suggested some hormonal activity. (6) We desire to extend these observations to additional material, and inasmuch as mole and chorionepithelioma are of rare occurrence we would greatly appreciate the help of others in supplying us with fresh, sterile specimens of these tumors.

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THE COLD WATER LAYER OF THE SCOTIAN SHELF

Probably the most important feature of the waters of the continental shelf, to the south of Nova Scotia, is the cold water layer of a temperature less than 5.0° C.—as low or lower than 0.0° C. This layer is found in summer at depths between 17 and 66 fathoms offshore, and between 33 and 80 fathoms inshore.[1] Considering the salinity of the waters of such temperatures, on the Scotian shelf, they may be classified as "bank" or "slope" water.[2] There have been two opposing views as to the origin of this water, one of which favors "winter chilling in situ" while the other favors "water movements from the east." A cooperative effort between the Fisheries Research Board of Canada and the Woods Hole Oceanographic Institution, during the winter of 1936, furnished the first extensive body of data for the assessment of the relative importance of these two points of view.[3]

The temperature and salinity data from a February section, extending outwards from Halifax to beyond the edge of the continental shelf, furnish the T-S diagram of Fig. 1. The volume transports in the

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[1] H. B. Hachey, *Trans. Amer. Fish.*, 66: 237–241, 1937.

[2] Paul Bjerkan, Can. Fish. Exped. 1914–15, Department Naval Service, Ottawa, 1919.

[3] The writer is indebted to Mr. C. O'D. Iselin, of the Woods Hole Oceanographic Institution, who agreed to the interchange of data.

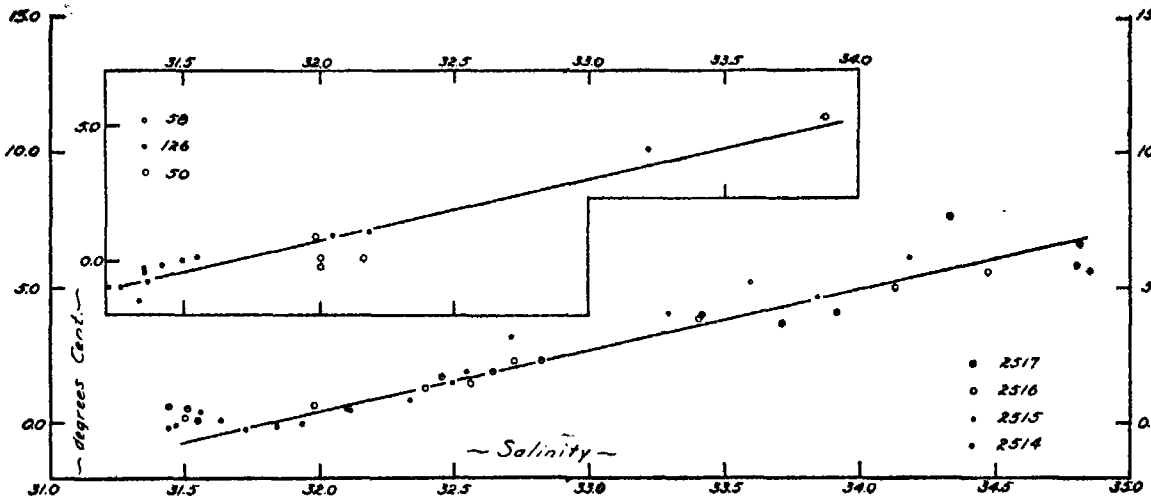

FIG. 1. T-S diagram of data from a section extending outwards from the coast in the vicinity of Halifax (station 58) to beyond the edge of the continental shelf (station 2,517).

upper seventy-five meters of water as calculated[4] are furnished in Table 1.

TABLE 1

VOLUME TRANSPORTS IN CU.M./SEC. IN THE UPPER SEVENTY-FIVE METERS BETWEEN PAIRS OF STATIONS, IN A SECTION EXTENDING FROM THE COAST (STATION 58) TO BEYOND THE EDGE OF THE CONTINENTAL SHELF (STATION 2517).

Stations	58–126	126–50	50–2514	2514–15	2515–16	2516–17
Transport	S.W. 103000	S.W. 371000	N.E. 25200	N.E. 13200	N.E. 53700	S.W. 59000

Resultant between 58 and 2517 is S.W. 441000

On the basis of the straight line relationship suggested by the T-S diagram, it may be stated that the waters of the February section are the result of the mixture of two water masses "A" and "B," which may be described as follows:

A—water, of a salinity less than 32.50% and of a temperature less than 1.0° C., and

B = water, of a salinity greater than 35.00% and of a temperature greater than 7.0° C.

The calculated resultant volume transport indicates considerable resultant movement through the section to the southwest in the upper seventy-five meters—441,000 cu.m./sec. This transport is concerned with what we have termed the A-water. The volume transport, in the upper seventy-five meters, between stations 58 and 50 is 474,000 cu.m./sec. There is a preponderance of comparatively low temperature and low salinity water between these two stations. The supply of A-water to the area depends, therefore, upon this southwest transport. The transport between stations 126 and 50 represents velocities of as much as 7 or 8 nautical mi./day. Therefore, the supply of A-B water, if produced on the Scotian shelf, is dependent upon movement, and is comparatively independent of "winter chilling in situ." This A-B water possesses the temperature and salinity characteristics of what constitutes the "cold water layer" of the Scotian shelf. It can, therefore, be readily appreciated that the most important feature of the waters of the Scotian shelf—namely, the "cold water layer"—is dependent upon "water movements from the east." This thesis will be more fully developed in a publication to follow.

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[4] A. E. Parr, *Bull. Bingham Ocean. Coll.*, 6: 3, 1–62, 1937.

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THE PRACTICE OF MEDICINE[1]

By Dr. RUFUS COLE

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HAVING lived until recently in the shadow of this enormous and beautiful pile of buildings, comprising the New York Hospital and Medical School of Cornell University, I am somewhat embarrassed to stand before this august assemblage of faculty and students and presume to bring you a message. My awe is a little tempered, however, by the recollection of a remark made by the Minister of Health of Egypt, who visited me at the Rockefeller Hospital several years ago. Thinking even one whose life had been spent in proximity to the pyramids might be impressed, I called his attention to your buildings and asked him what he thought of them. "I can tell better after a thousand years," was his cryptic reply. To-day the recollection of his remark makes me conscious of the ephemeral nature of most human undertakings, especially of commencement addresses, and boldens me to speak frankly.

To you, members of the graduating class, I offer my most sincere congratulations, and they are especially warm on this occasion since the degree which you have just received has real significance; it has been obtained only after a long residence in the university, and after you have carried on work as arduous, as intensive and as truly intellectual as that required by any university in the world for the doctor's degree, even for one in philosophy or in pure science.

Until a relatively few years ago the degree of doctor of medicine, even in the best universities of this country, signified something quite different from this. In almost all schools the chief emphasis was laid on vocational training. All of the teachers spent at least a portion of their time in private practice and, in selecting the material which they presented to their students, they chose that which was likely to be of immediate value in professional activities. Gradually, however, the teaching in the courses of the first two years came into the hands of men whose interests were not entirely related to the utilitarian aspects of their subjects. These men devoted their entire time to teaching and study in their respective fields, and the work of the first two years became of a real academic and university type. In the third and fourth years, however, the character of the work was not changed, the chief emphasis continued to be laid on the vocational aspects, the objectives of the teachers were to train students to make rapid diagnoses, to apply the forms of treatment considered to be most effective, and to provide their students with sufficient actual experience with patients that they might learn to prognosticate correctly the outcome in any individual case. At the completion of the medical course students were given the degree of doctor of medicine, "with all the rights and privileges thereto appertaining," indicating that they were competently trained physicians fully prepared for practice.

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[1] Address delivered at the commencement exercises of Cornell University Medical College, June 15, 1938.

The concept of the duty of the university, however, has now shifted. Since, as has been assumed, probably nine out of every ten men receiving the degree of doctor of medicine will spend the greater part of their lives in practice, it is obvious that the great desire of the university is still that society shall be provided with good doctors. This, however, is very different from an obligation to provide the community with trained practitioners. It may even be questioned whether the university is under any obligation to produce trained physicians at all, or is in a position to do so if it would.

During the last half century medicine itself has become a science. I do not intend to-day to discuss the definition of science. During recent years this matter has been sufficiently labored in connection with this very branch of knowledge, and in this debate even I have not been entirely silent. In any case, at the present time, when in the minds of many, even the educated, almost every field of human endeavor has become scientific, the term has lost much of its significance. Farming, hair-dressing, the giving of alms, office management, banking, horse-shoeing, and so on ad infinitum, all have become scientific. In all fields the outward trappings of scientific procedures have been adopted; numerical enumeration of items, at least when there are more than one, and especially when accompanied by graphs and charts, is sufficient to warrant the appellation scientific. It is not necessary, however, to worry about all this pseudo-science which surrounds us on all sides, even in the universities themselves.

I think even the most academically minded now agree that the subject of medicine, of disease, is a sufficiently important subject, and the mass of knowledge concerning it is sufficiently well organized and systematized to justify its designation as a science, and that its devotees, since they are pursuing its study by methods which are employed, and have been successful, in the other fundamental sciences, are worthy to be called scientists. Under these circumstances it seems that medicine is a proper subject to be taken into the university as a discipline worthy to be studied, even if all applications were entirely lacking.

But even if medicine is a science worthy of treatment by scientific methods, the question still remains whether there are any reasons why the future practitioner of medicine should pursue this subject from this point of view. It is theoretically possible that a student might, merely through repeated observation and didactic instruction, become familiar with the characteristic superficial features of disease, that he might learn empirically the various procedures employed in treatment and that he might even, through experience alone, acquire a certain skill in prognosis. Indeed, for many years this was about all that was attempted in the training of physicians. But the university, and even society at large, now demands that physicians shall be familiar with what is known about the nature of the processes constituting disease and of the lesions associated with them. The phenomena of disease are natural processes occurring in conformity with the laws of nature, so far as these are known at present, and these phenomena can only be understood by using the methods universally employed in revealing the mechanisms of other natural events. These are the methods of science.

During the period of your residence the university has placed facilities at your disposal to enable you to become scientists. It assumes that you have made good use of these opportunities. You have acquired much knowledge, but more important, it is hoped that you have obtained mastery of a method. The university, therefore, welcomes you into the society of scholars.

I take it that during your work in the university some of you have become especially interested in the subject-matter and the techniques and methods of one or other of the so-called underlying medical sciences, such as physiology, anatomy or biological chemistry, and have decided to make the study and teaching of one of these branches your life work. The division of science into several disciplines is a purely artificial one and only occurred when the accumulated knowledge became so great that no individual could be a master of the entire domain. The aspiration of Francis Bacon was found to be one impossible of fulfilment. On the other hand, the most productive scientists have been those who have not surrounded themselves by a closed wall, but have provided numerous apertures through which they could pass, to roam in surrounding fields at will. Anatomists now study function, and physiologists, structure. Chemists bring their technique to the solution of important immunological problems, and even professors of medicine attempt to solve questions concerning disease by the employment of the methods of physics. For the advancement of knowledge the important matter is the formulation of problems. In the attempt to solve them each worker must use the tools to which his hand is fitted. Most of you have undoubtedly read the life of Madame Curie and have been inspired by learning how, through the exercise of her indomitable will, she overcame obstacles and accomplished her purpose. Don't worry too much about the nature of the path, whether it be rough or smooth; keep your eye on the goal. What you have learned of the science of medicine will make you better able to teach, inspire and lead those who will practice, no matter which field of biological science you now or later decide to cultivate.

Some of you undoubtedly hope to give your entire time to the study of the science of medicine itself and to become university professors of medicine or to spend your lives in attempting to solve the riddles of disease. For you the training in the underlying sciences has been indispensable. You can not study alterations in form or function without clear ideas concerning that which is changed.

Most of you, however, will engage in the practice of medicine, and to you I would speak especially. The university believes that it has made it possible for you to become good doctors of medicine. But are you now trained physicians ready for practice? That is another matter.

The statement made by Professor George William Palmer in the life of his wife, Alice Freeman Palmer, deserves repetition. In recounting her interest in domestic affairs, in spite of her preoccupation with intellectual matters, he says, "When at one time she was struggling with a new cook on the subject of bad bread, and after encountering the usual excuses of oven, flour and yeast, had invaded the kitchen and herself produced an excellent loaf, astonished Bridget summed up the situation in an epigram which deserves to be recorded; 'That's what education means—to be able to do what you've never done before.'" But does that suffice when dealing with such a complicated subject as disease, with its protean manifestations and with the life of human beings at stake? If the experimental loaf of bread turns out sour or heavy you can throw it out and begin again.

You may have knowledge of the structure and functions of the human organism in health, even knowledge of a kind which Huxley describes as "the sort of practical, familiar, finger-end knowledge which a watchmaker has of a watch, and which you expect that craftsman, as an honest man, to have when you entrust a watch that goes badly to him," a knowledge to be had only by long concentration of your minds for long periods of time "upon all the complexities of organ and function, until each of the greater truths of anatomy and physiology has become an organic part of your minds—until you would know them if you were roused and questioned in the middle of the night, as a man knows the geography of his native place and the daily life of his home." Moreover, you may also know about disease so that you may be able to picture in your mind at a moment's notice the characteristic lesions of all known diseases, and may be able to pass a perfect examination on all that is known of the functional disturbances following all types of injurious agents, and be able to describe minutely the lesions produced by them. In spite of all this, in my opinion, you would not necessarily be a good physician. Though the physician speak with the tongues of professors and savants, and have not experience and technique, he is become as sounding brass or a tinkling cymbal. It is absurd to assume that you are able to employ surgical methods successfully or to employ the various techniques now used by physicians in treatment. Even to make diagnoses with the rapidity which is necessary in actual practice requires the use of tricks (in the best sense), particular modes of thought and action, with which you are not familiar. In other words, there is such a thing as the technique of practice and those who deny it have never had the experience of being put to the test. This technique you have not learned and can not learn in the true university medical school. Indeed, that school best deserves this title that bothers itself least with attempting to do what is impossible. Moreover, no one, except the self-deluded men who examine you for license to practice, expects you on graduation to be proficient practitioners. This does not mean, however, that you are not well prepared to master the techniques necessary to make you good physicians.

It is not easy to differentiate sharply between the study of the science of disease and the practice of medicine. It is largely a difference of point of view, of emphasis. One may say, however, that the student of the science of disease investigates disease as it affects mankind. The practitioner is primarily interested in the diseased individual. The former may be interested in features of disease which at the present state of knowledge may seem to have little or no significance. The physician, for practical reasons, must concentrate his attention on those features whose importance has been demonstrated. It is not merely a matter of conservation of time, though this is important. The university student may spend days in the investigation of a single case. The practitioner must investigate, judge and act quickly. Otherwise he starves to death or most of his patients receive no attention whatever. The university lays stress on complete understanding, practice lays stress on skill. It is not a question of treatment. The movement at the end of the last century took care of that. The patient no longer employs a physician merely to have him administer remedies. He comes to the doctor when he is suffering from disease, he wants to be restored to ease or to be relieved of his ails when he has an ailment. But what the patient rightly demands, first of all, on the part of the physician is understanding. Not merely understanding of the physical disharmonies which constitute disease in the abstract, but understanding of his entire constitution as an individual. Both the university student and the practitioner are interested in treatment, but the practitioner is especially concerned with the techniques employed in actual application in the individual case. Whatever the differences, however, the university student and the practitioner must both employ the methods of science. They must both have the scientific habit of mind, and this is especially what the university should give. Both must have curiosity, the desire to learn; both must have honesty, and both must be critical. Unverified opinion can have no place as guides to action. To the practitioner every individual case presents a problem. He must observe, reflect, form an hypothesis and proceed to verify it. The analogy with music is not unilluminating. The study of the theory of music, its history, its relation to psychology are true university subjects. Training of students to be proficient performers on a musical instrument is not a legitimate function of the university, though it is true that some so-called universities so consider it.

Now if you have not yet acquired the necessary technique and skill for practice, where and how are you going to get it? There is no open sesame. It can only be acquired by practice itself and by hard unremitting labor. That does not mean that you can not be aided by observing the methods of master workers, but you can never acquire it through the best correspondence schools of our most famous universities. In earlier years the rudiments of the technique of practice were obtained by following a preceptor, and, so far as it went, this was not a bad way, though it had manifest disadvantages.

To-day the preceptor system has been replaced by the hospital internship. According to the *Journal of the American Medical Association* there are to-day 712 approved hospitals with positions for over seven thousand interns. In addition, there are three thousand positions open for residents in special hospitals. The total number of graduates from approved medical schools last year was 5,377. It is evident that every graduate in medicine has the opportunity to spend one or more years (in a considerable number of instances with pay) in obtaining experience in practice as hospital interns, and almost all graduates now make use of this opportunity. In my opinion there are manifest defects in the intern system as it exists at present. Indeed, I feel that it is the weakest link in present-day medical education. The analogy of the apprentice and the intern has been taken too literally. In most cases all the hospital does is to offer opportunities to the intern. The preceptor cared whether the student did or did not learn, the hospital usually does not care. But hospital physicians can be interested in the training of interns, to their own as well as the student's great advantage. Hospital authorities can undertake more seriously their educational responsibilities.

What can the hospital do? In the first place, it can realize that its group of interns is composed of highly educated, cultivated, serious men whose highest ambition is to serve ably the patients who are under their care, and whose greatest desire is, through practice, to become not only technically skilful, but also more gentle, more humane, more wise. The hospital can provide facilities so that interns may live like cultivated men and students, not like traveling salesmen, and this does not mean luxurious lounges, more bathrooms, better plumbing and luxurious food—not provision for higher standards of living, but for higher standards of work and study. This was clearly recognized by John Billings, a man whose wisdom and greatness we are only gradually coming to recognize, the man who was responsible in large measure for the success and enormous influence of three great institutions, the Johns Hopkins Hospital, the unsurpassed Army Medical Library in Washington and the New York Public Library. When he planned the Johns Hopkins Hospital the residents' quarters were placed in the best part of the main building, large, light, airy rooms with commodious book shelves, and, most important of all, they were in proximity to the library. He realized that the library should be a good one, freely accessible, so that interns not only may read there but that they may take books to their rooms, as many as they like. Hospital libraries should not be mausoleums or storage warehouses. In recent years when visiting hospitals I have made a point of seeing the interns' rooms. What do you think I usually found, even in some of the best and most modern hospitals? Small, dark rooms, containing a bed, a chair or two, a small desk, apparently little used, possibly a few photographs of members of the family or of those who at some future time might become members of the family, and a few books—a very few, and these mostly text-books, remnants of the student life. I didn't feel so disappointed not to find some evidences of interest in literature or music or pictures, though I am not one of those who believe that culture in the best sense is of no importance in the life of a doctor, but I was surprised to find no evidence of any interests at all, not even an interest in science. To find that a young man could not only go through college but have acquired a university degree and have no interests outside of his daily job did surprise me. While the hospital can not create these interests, it can at least assume that the intern has them. The hospital should not treat interns as employees, make them punch a time clock (of course figuratively) and provide to the minutest detail the kind and amount of work they shall perform. Interns must have freedom. This I realize in large hospitals is difficult, but it is not impossible.

In discussing the responsibilities and opportunities of the visiting physicians, I can only look back on my own hospital days and recall my experiences under Dr. Osler. I feel that he was an ideal chief. Personally interested in every intern under him, considerate of their sensibilities as he was of their time, he seized on every least evidence of curiosity on the part of an intern, stimulated his interest and aided him with advice and help. As those of you know who have read his great biography, his contacts with his interns were not entirely confined within the hospital wards. He never missed a meeting of the various hospital medical societies. I once remember when he was hurrying off after dinner to one of these meetings, an attractive young assistant was drumming on the piano. "Jim, aren't you going to the meeting?" "No, I don't get much out of these meetings." "Do you think I do?" was the reply, and he slammed the door and ran down the steps. But above all he influenced his interns by his example. He taught them how to become good doctors by being one himself. He was interested in his interns, and this every hospital physician can be.

It has sometimes been felt that practitioners no longer have opportunities to help and guide young men and that, as a result, the day of great clinical teachers is past and that society thereby suffers. As a matter of fact, all practitioners connected with the large hospitals now come daily into contact with a group of highly educated young men who are, or should be, familiar with the fundamental nature of disease. By spending a limited amount of time with them, by guiding them, working with them, these practitioners may be of very great educational service. The opportunities for their own development are also there, the greatest teachers have always said that they received more from their pupils than they gave. Moreover, these opportunities are no longer confined to the large centers. With the development of hospitals in the smaller cities, frequently as well equipped as those in great centers of population, the practitioner in a small place now has the same opportunity to become a great teacher as had Daniel Drake in the little Transylvania University beyond the mountains. A group of skilful and devoted physicians in a country hospital who give themselves to the inspiration and training of their interns can to-day cause a path to be beaten to their hospital doors by the best educated young men in the science of medicine that have ever been produced. Young men have a way of being drawn to those who have something to give.

But after all, whether interns shall become good doctors or not depends upon the interns themselves. To make use of the knowledge you have obtained in the university and to retain your scientific spirit now become your chief concerns. In order to obtain complete understanding of your patients it would be necessary to study everything connected with them. Of course, that is impossible and much must be omitted. The matter of picking and choosing your procedures becomes of great importance, and the facility of doing this wisely is one of the qualities that determine the good physician. Our hospitals are now great organizations in which there are arrangements for making all kinds of technical investigations. The intern becomes a part of this organization, and he is able to use any one of a dozen different laboratories to aid in his study. This is all very useful, but it carries with it obvious dangers. The student begins to deal with formulae, with words, instead of with the things themselves. In the middle ages medicine was in the hands of physicians, surgeons and barbers, and, as Garrison says, "the barber was in some respects the most worthy of the three, since he was driven to study nature at first hand." One of the chief disadvantages of the present arrangement is that when the intern becomes an independent practitioner, as most of you will and must, this convenient arrangement for calling on others will no longer be available to you. Aid you must and will have, but it must be more carefully chosen. At the present time a large part of the work of the contributing services in the hospital is probably unnecessary. It results from the fear of omitting something. Seeking for completeness is mistaken for striving for perfection, which is the aim of the artist in every field. The best painters have not been those who have attempted to depict each individual hair. It is this fear of omission that impels taking the most minute and extensive histories, and the recording of routine elaborate physical examinations, all of which occupy so much of the intern's time and leave so little opportunity for thinking and for independent action. It is unnecessary for me to attempt to mention the numerous laboratory procedures that have been introduced in recent years and have come to be employed in a routine, instead of a discriminating, manner. All this is not science. Darwin didn't make and record all his numerous observations for the sake of completeness. He early formulated an hypothesis, which he was attempting to verify. The intern should be given opportunity to employ the methods of science in solving his problems, not to become mere clerks and technicians. That not all interns take advantage of opportunities when they have them is obvious. How many interns keep their own records of cases, classify them, brood over them, and try to formulate their own pictures and concepts, and try to rationalize the methods of treatment they employ? Records of cases carefully abstracted, compared and digested are of infinitely greater educational value than random experiences, however exciting and interesting. To pass through your intern years in a fever of agitation, interested only in obtaining a rapid series of impressions, will add little to your real experience or improve your training for practice. Stimulated to collect and record and abstract all the cases of pneumonia occurring in the hospital during my own intern years, this practice gave me an interest in this disease which has never left me and has proved to be a source of great and rewarding satisfaction. It has been said that if a student learn syphilis he knows medicine. This can be said of any disease. An interest in any condition will lead a student into paths covering the whole range of pathology.

The life of an intern to-day is difficult. His duties are many and arduous. But the difficulties are not so great that they can not be surmounted. When I see the long lists of interns and residents in good hospitals, and contrast this with the handful of workers forty years ago, I can not believe that, in spite of the great increase in the methods employed, the intern's life need be more strenuous to-day. The master-word in the hospital, as in the university, is still *Work*. I once had a temperamental resident from one of the Balkan states who told me that he was ready to die for science. My reply to him was that it is much more important to work for it.

Hospital days are and should be laborious days, but they also may be days of the greatest joy and pleasure. For the first time you will come into a position of real responsibility for the lives of your patients. If it is the right kind of a hospital you will enter intimately into the lives of fellow human beings and see them stripped as bare of all pretense, of all artificialities, of all their former surroundings as they are of their clothes. It is a cold and unimpressionable individual who is not strongly moved by this close contact with those who are in distress, who are laying bare their deepest secrets and thoughts, who frequently are seeing death eye to eye. Your relation to your patients may resemble that of the family doctor. The close companionship with your associates, who are undergoing the same experiences, makes for sympathetic fellowship and stimulates close and enduring friendships. The companionships of school days, the attractions of college and club life can never make the same impression as do the hospital intern days.

During your intern days the hospital should be your home, your workshop and your playground. You should need nothing more. Learn to shun outside affairs that will complicate your life and disturb concentration on your work, rejoice if you are too poor to own an automobile to carry you from the straight road, avoid the movies, you will find sufficient tragedy as well as comedy close at hand, above all, avoid like a plague entangling affairs of the heart. This latter advice in these days, I fear, is like locking the stable door after the horse is stolen, since hospitals are now hard put to it to find interns that are not already married. But after forty years of hospital experience I am still convinced of the soundness of Dr. Osler's advice to "put your affections in cold storage during your intern years." The joys of family and domestic life will be all the greater because waited for and worked for.

And after the hospital will come practice. As you know, this word is employed in two ways, first, as the musician practices to acquire proficiency, and second, as the doctor or lawyer practices to pursue his profession. When we speak of practicing medicine let us not forget the implication of the word, through practice we become proficient. Bear in mind that education does not end with the intern years, it should extend throughout your entire professional life. Power grows as experience extends. The difficulties of maintaining a scientific attitude will be enormously increased once you have left the protecting walls of the hospital, no matter how insecure that protection has been. Amid the distractions of domestic life, the competition and rivalry in professional work, hurt by the apathy of the public for intrinsic merit,—whether you will be able to continue to exercise the scholarly and scientific point of view will depend largely on the use you have made of your hospital years. The best guard against retrogression is a constant desire to learn more about the real nature of disease, and particularly about some particular disease. In other words, have a problem. Of course, with all the distractions of practice, the methods you use will have to be comparatively simple ones. But if you are supplied with understanding and insight, microscopes of low power are sometimes able to reveal important truths. Some of the most important medical discoveries have been made by men in active practice. Time extends for those who have a driving passion to learn. The example of Dr. Meltzer should impress all of you. For many years he drove about New York every day with a horse and buggy seeing patients; then, tying his horse to a hitching post, he spent all the time he could spare in a laboratory. During this period he made most important contributions to medicine and physiology. Later, after the Rockefeller Institute was established, he went there to work, and died one of the most productive students of disease that our country has had.

To maintain the scientific habit of mind it is not essential that a physician work in a laboratory, but, if he has curiosity, it is almost certain that he will be drawn there at least occasionally. Thirty years and more ago the physician who kept a microscope under a bell jar in his consulting room was spoken of with derision. How much more serious to-day that so many young doctors with wonderful scientific training, even if they have a microscope, never look through it from one year's end to another. Many, possibly most, men now in practice have no laboratories of their own, and many never enter a laboratory after their student days. All of them, however, hire technicians or send specimens to some commercial laboratory for the most complicated tests. Most of them are of the routine variety, done by technicians who have no conception of the meaning or purpose of what they are doing. Doctors have their patients pay large sums for blood examinations or for "having blood chemistry done" (whatever that may mean, and the doctors themselves frequently do not know) or for routine x-ray examinations that may be useless so far as the patient is concerned, and are of no real interest to the doctor. All this is not science. Let us take care that in the process of attempting to make medicine more scientific, physicians themselves do not become less scientific.

In spite of all that I have said, there is no question but that the practice of medicine to-day is far better than it was forty years ago. But one sometimes wonders whether, considering all the great additions that have been made to our knowledge of disease, and in view of all the time and money and thought that have gone into medical education, the doctors of to-day are really as able as we like to think. When one considers how slowly and ineffectively and incompletely therapeutic measures which have well-established value have been applied, such as those which are useful in syphilis, diabetes, pernicious anemia and pneumonia, to mention only a few, one wonders. That it has been necessary for governmental agencies to engage in active campaigns to promote the proper and extensive use of these and other therapeutic measures is a sad commentary on our profession.

Certain critics blame the defects entirely on the present method of university education. They say that it is suitable only for the few gifted students and not for those who are to compose the rank and file of the profession. Some would have training for practice carried through the entire four years of the medical course. Others believe that during the study of the underlying sciences more stress should be laid on practical applications. It seems to me that these ideas arise from mistaken notions, sometimes even by the universities themselves, as to what the university is attempting to accomplish, and above all from an entire disregard of the educational importance of the hospital and of practice itself. It is obvious that men undertaking the work leading to a doctor's degree should have the proper background and training and have the mental qualifications required for true university work. They should have that desire to learn, that devotion to learning, that inflexible will that is necessary if one is to lead the true intellectual life. They must be interested in the subject itself, and disinterested in the material rewards, social opportunities and stimulating emotional experiences associated with the practice of medicine. They must regard the practice of medicine as an intellectual and humane undertaking, a vocation, not merely an occupation, a learned profession, not a skilled craft.

Do the university schools of medicine treat the students as independent, thoughtful workers, stimulated by an insatiable curiosity and moved by an inordinate desire to learn, and have the various departments been organized with an eye to providing students with opportunities to effect this will and satisfy this desire? If the will is not fixed and the desires undeveloped, is the main effort, by example rather than by precept, to stimulate the development of these qualities and inspire these enthusiasms? These, to my mind, should be the important endeavors, rather than to urge the students to acquire all available information. The employment of laboratory methods alone will not accomplish these ends. To carry out required laboratory routine procedures may enable students to learn and understand more easily and may make information more real, but unless the work is conducted by the students in an independent manner and they be given opportunity to learn for themselves, the students will acquire nothing more than bare facts, facts which some of them at least could have obtained more rapidly and easily from books. While certain students may be more readily stimulated to work and study in their earlier years if the relation of the underlying sciences to disease is indicated to them, it seems to me unimportant whether the professors in these sciences are familiar with medicine or not, that is, whether they possess degrees in medicine. The great school of physiology that developed under the influence of Michael Foster was in Cambridge, far removed from departments of medicine. And it has exerted an enormous influence, not only on the increase of knowledge concerning disease but on the practice of medicine and on practitioners as well. Let students obtain a real interest in physiology and, if they have intelligence, the bearing of physiological facts will be obvious to them when they study about disease.

That medical students at present acquire an enormous fund of information is certain. In interviewing students fresh from the schools I frequently stand amazed by the fluency and skill with which they discuss the most complicated subjects of physiology and pathology and the very latest discoveries in medicine and related sciences, at times even before the ink is dry on the reports. One sometimes wonders, however, if range of information is necessarily identical with depth of knowledge, or whether the facts have been digested and transmuted into wisdom. That medical students possess so much information is not surprising. For four years each of the various professors, and there are very many of them, have attempted to compel the students to learn everything that is known about his particular subject up to the moment of going to press. It is not necessary to recapitulate the large number of special divisions into which medicine has been divided; the students are expected to take at least a few meals in each one of them. There is so much hospitality that the meals all turn out to be banquets. Is it any wonder that most of the students have indigestion, mental as well as gastric? In recent years many attempts have been made to correct this situation, and they are undoubtedly in part successful, but I am sure many deans still have very bad hours worrying for fear their students will not have mastered every subject in the field of medicine. So far as I can see there is only one remedy. Let it be required that every professor, every teacher, each year pass an examination not only in his own subject but one in every other subject in the curriculum. Let the professor of biological chemistry keep familiar with the latest methods in obstetrics, the professor of ophthalmology be informed of progress in physical chemistry and endocrinology, the professor of bacteriology keep abreast of improvements in x-ray therapy. It is frequently held that at least once in their lives all medical students should have heard about all that is known in the whole field. A doctor should never be ignorant of any fact relating to medicine! But is this necessarily education on the university plan? Is this cramming with facts scientific education or does it produce scientists?

Over thirty-five years ago, long before the first university department of medicine was established, the following words were uttered by a man who was primarily a practitioner and clinical teacher: "All that the college can do is to teach the student principles, based on facts in science, and give him good methods of work. These simply start him in the right direction, they do not make him a good practitioner—that is his own affair. To master the art requires sustained effort, like the bird's flight, which depends on the incessant action of the wings, but this sustained effort is so hard that many give up the struggle in despair. And yet it is only by persistent intelligent study of disease upon a methodical plan of examination that a man gradually learns to correlate his daily lessons with the facts of his previous experience and with that of his fellows and so acquires clinical wisdom."

Let the university heed that it turns out men who have the scientific habit of thought, not merely men who are stuffed with facts. Let us, however, not ask too much of the university. If the prevailing standards of practice do not fulfil our expectations, let us not blame this all on the university, but let us keep in mind the parts which the hospital, the visiting physicians and even the interns and practitioners themselves should play in the training of good physicians.

If to-day I have attempted a "counsel of perfection" it has not been uttered in any spirit of arrogance or criticism. We are still far from the perfect state. The future rests with you who are beginning your careers. You are fortunate in the choice of your time. May you continue to be scientifically and critically minded. May you continue to be students as long as you live.

OBITUARY

ERNEST WILLIAM BROWN

In any account of Brown's life his work on the problem of the motion of the moon must necessarily occupy the central place. At any time during a period of fifty years he was working on some phase of this subject. His lunar theory has justly been called definitive. The creation of this theory and the construction of his "Tables of the Motion of the Moon" are among the greatest accomplishments in the history of gravitational astronomy.

In the summer of 1888, then a student at Cambridge, England, he began the study of Hill's papers on the lunar theory at George H. Darwin's recommendation. In a series of publications beginning in 1891 he presented theoretical developments inspired by Hill's work, and their numerical application, *i.e.*, the coefficients of certain classes of inequalities in the motion of the moon. For six years he continued his preparatory studies. His mastery of the whole field is apparent in his "An Introductory Treatise on the Lunar

Theory," published in 1896. Intended to be an introductory text-book, it is elementary in many parts, but it also deals with the advanced phases of the subject.

The systematic development of the theory began in 1894, and in 1908 the fifth and last part of the theory appeared. In an address in 1914 he said: "My own theory, which was completed a few years ago, is rather a fulfillment to the utmost of the ideas of others than a new mode of finding the moon's motion. Its object was severely practical—to find in the most accurate way and by the shortest path the complete effect of the law of gravitation applied to the moon. It is a development of Hill's classic memoir of 1877."

This statement is typical of the modesty which he always showed in referring to his own contributions. It does not emphasize his own resourcefulness in finding that "shortest path." His development of the theory was by no means a slavish following of a standard pattern. He did not hesitate to change from one form of the equations to another if he saw a good reason for doing so, and he introduced minor and major changes of procedure whenever this would shorten the work. This freedom in handling problems in dynamics was a characteristic feature of his work throughout his life. He had no patience with theorists who apply "hit-or-miss methods," as he used to say.

The most original part of the lunar theory is the last part, in which the effects upon the moon's motion due to the attractions of the planets and the deviation from sphericity of the earth and the moon were obtained. There is perhaps no other field in celestial mechanics where a more careful treatment is necessary in order to avoid pitfalls. Probably no mathematical astronomer has ever shown greater ability than Brown in dealing with such a problem.

The accuracy of the solution of the "main problem" is of a totally different order than that of solutions that preceded it. In Hansen's theory some coefficients are in error by some tenths of a second of arc. Delaunay's theory is seriously hampered by slow convergence, some of the more difficult terms being in error by a whole second of arc. Brown's solution gave the coefficients to one one-thousandth of a second of arc, and very few coefficients greater than that value were not obtained. That this accuracy was actually reached was confirmed by the preliminary results obtained in a numerical verification of this part of the lunar theory. This work was carried out by his pupil, Dr. W. J. Eckert, in close cooperation with Brown during the past few years.

Immediately after the theory had been completed he began preparations for the construction of the tables. His approach to this work is again an example of thoroughness. Hansen was a past master in the art of tabulation, but Brown found it possible to introduce a number of important improvements. The most ingenious original feature is the arrangement of the single-entry tables, in which form the largest terms in the moon's motion are tabulated. The perfection of the tables was to a large extent due to the efficient assistance by Dr. H. B. Hedrick, who was employed as chief computer during nine years. In later years he spoke frequently with admiration of Hedrick's work.

While the construction of the tables was in progress a comparison with observations was made in order to ensure that the best possible constants were used in the final tabulations. A proof of the accuracy of this discussion, and of the lunar theory, was obtained some years ago when Spencer Jones completed a revision of Newcomb's occultation work. From totally different material he derived results that were in excellent agreement with those obtained by Brown.

After the tables were completed his most notable contribution connected with the motion of the moon was the well-known publication in 1926: "The Evidence for Changes in the Rate of Rotation of the Earth. . . ." A comparison of the differences between observation and theory in the longitudes of the moon and the sun was used to advance the explanation that both are due to changes in the rate of rotation of the earth.

The progress toward the present status of our knowledge about the earth's rate of rotation was not made in one step by a single investigator. It is generally agreed, however, that Brown's contributions were the most important and the most consequential ones. His definitive evaluation of the planetary perturbations marked the end of a long period of doubt whether the observed motion of the moon could be accounted for by gravitational theory alone. His contribution of 1926 marked the beginning of an era in which the rotation of the earth is definitely known to be affected by irregular variations. This problem had his most vivid interest ever after. His occultation campaign and his discussions of lunar observations during the last twelve years of his life were part of his study of the rate of rotation of the earth.

Until 1910, when the lunar theory was finished and the work on the tables was well in hand, Brown devoted but a small portion of his energy to original studies of subjects not intimately related with the lunar problem. From then on his activity covered a wider field. With the exception of occasional studies on a variety of topics his central subject was the study of gravitational problems presented by the solar system by quantitative methods. In appraising the value of these investigations it should be kept in mind that he was seeking new methods and that he was always attracted by the most difficult problems. His first theoretical papers on the Trojan Group were later followed by a general theory, applicable to all planets of this group, and especially to the more difficult ones having a large amplitude of libration. The study of the motion of the eighth satellite of Jupiter is an example of his preference for difficult problems.

Gradually Brown became actively interested in the more general problems present in the development of theories of planetary motion. His contributions to the theory of resonance were part of these investigations. He also laid the foundation for the construction of the "Tables for the Development of the Disturbing Function" (1933). Most of his contributions in this field were collected in a coherent presentation in the treatise "Planetary Theory" (1933), written in collaboration with Professor C. A. Shook.

During the last three years of his life the "main problem" of the lunar theory had his attention again. This led to several separate investigations of considerable importance. The most noteworthy of these is the treatment of the stellar problem of three bodies. His analysis of this problem showed again his ability to adapt available methods to the treatment of the special problem before him.

At the very early age of thirty-one he was elected fellow of the Royal Society of England. This was the beginning of a long sequence of honors that continued throughout his life.

In 1891 Brown came to the United States to become instructor of mathematics in Haverford College. Two years later he was promoted to the rank of professor. He remained at Haverford until 1907, when he became professor of mathematics in Yale University. He served Yale until his retirement in 1932. The appointment at Yale came when the lunar theory was nearly completed, and the construction of the tables loomed as the next phase of the work. Arrangements were then made by which Yale University undertook the cost of their calculation, printing and publication.

In earlier years Brown taught various subjects in pure and applied mathematics; in later years his only courses were elementary and advanced dynamics and celestial mechanics. Many of his students kept in touch with him in later years, and some became lifelong friends.

His relations with Yale Observatory, which were entirely unofficial with the exception of a period during which he was acting director, were mutually beneficial.

He was an active member of the American Mathematical Society, was editor of the *Transactions* and of the *Bulletin* for a number of years and president for two years, 1914–16. Of the American Astronomical Society he was president for three years, 1928–31. Since 1911 he was associate editor of the *Astronomical Journal*.

He was born in Hull, England, on November 29, 1866, and died in New Haven, Connecticut, on July 22, 1938. He was unmarried.

DIRK BROUWER

YALE UNIVERSITY OBSERVATORY

WILLIS RAY GREGG

DR. WILLIS RAY GREGG, late chief of the U. S. Weather Bureau, died in the Blackstone Hotel, Chicago, on Wednesday evening, September 14, 1938, where he had been attending an aviation conference between the Civil Aeronautics Authority and the Air Transport Association of America and where he was stricken with coronary thrombosis on the afternoon of Wednesday, September 7. Dr. Gregg, a descendant of James Gregg, who went from Ayrshire, Scotland, to Ireland in 1690, and thence to America in 1718, was born on January 4, 1880, at Phoenix, N. Y., where he grew up on a farm.

His formal education, attested by a B.A. degree in 1903, was obtained at Cornell University. An honorary Sc.D. was awarded to him in 1937 by Norwich University. On March 1, 1904, he entered the Weather Bureau as an assistant observer at Grand Rapids, Michigan. After a service of nearly three years, first at this station and later at Cheyenne, Wyoming, he was transferred to the Bureau's research observatory at Mount Weather, Va., on the crest of the Blue Ridge, 45 miles from Washington. Here for seven years he made important studies of the upper air—a line of investigation with kites and balloons that then was rapidly developing in many countries owing largely to the aid the knowledge thus obtained of winds and weather was to the whole art and practice of aviation. In November, 1914, he was called to Washington as assistant chief of the section of aerology, a section that soon became a division. In 1917 he was made chief of this important division, in which capacity his counsel and active aid frequently were requested by other agencies of the government and by civilian organizations, and always freely given whatever the sacrifice of time and effort on his part.

This wide experience, together with his profound sense of justice, untiring industry, even temper and cheerful optimism, well fitted him for the important position of chief of the Weather Bureau, to which he was appointed on January 31, 1934. This was a high honor, richly deserved, but it carried with it responsibilities, burdens and worries—worries about meeting rapidly increasing demands with a nearly stationary personnel.

Owing to his pleasing personality, ability and willingness Dr. Gregg's services were sought for in many lines. He was active as a Mason and was a past master of his lodge; in his church he sang in the choir and was a vestryman; in science he was a member of the National Advisory Committee for Aeronautics (chairman of the executive committee and of the subcommittee on meteorological problems), International Meteorological Organization, International Meteorological Committee, the Guggenheim Committee on Aeronautical Meteorology and of several other organizations and committees of like nature, including the Royal Meteorological Society and the American Meteorological Society (treasurer, 1923–1935, president, 1938). He also was a member of the Washington Philosophical Society (treasurer, 1921), Washington Academy of Sciences, American Geophysical Union (chairman of the section on meteorology, 1932–1935) and fellow of the American Association for the Advancement of Science. He was a member and frequenter of the Cosmos Club, in which he had many close friends.

In addition to technical articles, he wrote also the monograph, "Aerological Survey of the United States," 1922 and 1926, and "Aeronautical Meteorology," 1925, second edition, 1930.

On October 15, 1914, he married Mary Chamberlayne Wall, daughter of an Episcopal minister of Berryville, Va. He is survived by his wife, one daughter, Ruth Marguerite, a brother and three sisters.

W. J. Humphreys

RECENT DEATHS AND MEMORIALS

Arthur Herman Adams, a consulting engineer of New York City, died on September 25 at the age of fifty-nine years.

The Rev. Walter G. Summers, head of the department of psychology at Fordham University, died on September 24 at the age of forty-nine years.

Dr. Arthur Stanley Mackenzie, from 1911 to 1931 president of Dalhousie University, died on October 2 at the age of seventy-three years. From 1891 to 1905 Dr. Mackenzie was professor of physics at Bryn Mawr College and was later for a short time head of the department of physics at Stevens Institute of Technology.

Dr. A. Rosenthal, a neurologist of Jerusalem, was killed on September 14 when passing through Ramleh, where vehicles were being stoned.

Dr. Volkmar Kohlschütter, since 1909 professor of inorganic and physical chemistry at the University of Bern, died on September 10 at the age of sixty-five years.

Nature reports that the Dutch Medical Association, the Leyden Faculty of Medicine and the Society of the History of Natural Sciences of Leyden organized a celebration beginning on September 23 to commemorate the two hundredth anniversary of the death of Herman Boerhaave. Visits were paid to the old St. Cecilia Hospital, where Boerhaave gave clinical lectures, his country house "Poelgeest" near Leyden and the village of Hardewyk on the Zuyder Zee, the seat of the university where Boerhaave presented his inaugural thesis on July 15, 1693. It is planned to publish a commemoration volume.

SCIENTIFIC EVENTS

THE STANDARDIZATION WORK IN PHOTOGRAPHY

Following a request from the International Standards Association that the United States take leadership in standardization work in the field of photography, the Standards Council of the American Standards Association meeting in New York approved the undertaking. A new committee will be organized representing manufacturers, distributors and users of photographic materials in the United States. Its duties will be: (1) To initiate an American Standards Association project on standardization in the field of photography under the leadership of the Optical Society of America; (2) to take leadership in the international project on photography as well as cooperating in the work.

The work to be undertaken will include formulation of definitions, dimensional standards and recommended practises in the field of photography; and the establishment of methods for testing, rating and classifying the performance characteristics of materials and devices used in photography, including its industrial applications, but excluding cinematography.

Part of the work of the committee will consist in collecting and codifying what has already been done in the above fields. For instance, efforts have already been made to set up logical and systematic nomenclature in small sections of the photographic field. Considerable progress has also been made by manufacturers of sensitive materials and photographic equipment in establishing definite dimensional standards for materials and appliances. The role of the new committee in these cases will be to bring such manufacturers together and obtain agreement so that greater interchangeability may be achieved.

A detailed outline of photographic problems for the new committee's consideration was read and approved. While some of these are probably not at the present moment ready for attention, others have already been the object of considerable study and may be standardized rather easily and promptly. Many items not at present included may be added later on.

Work, as at present planned, will affect amateur, portrait, commercial and news photography, as well as process work, aerial photography, radiographic and photomicrographic photography, documentary, medical and photomechanical photography. It will also include work in the graphic arts and in wired and wireless transmission of pictures.

The field of photography is so broad and diverse that the matter of personnel for the new committee assumes unusual importance. Forty organizations are to be invited to appoint representatives. Eleven of these, including Federal Government departments, are user groups, twelve might be classified as general interests, sixteen are manufacturers of photographic materials, and one a distributor organization. The wide scope of the work will undoubtedly require that subcommittees be appointed to make recommendations as to the desirability and feasibility of standardization within specific and limited fields.

AWARDS OF THE LALOR FOUNDATION

The Lalor Foundation announces its third series of fellowship awards which authorizes grants to the amount of $25,000 for the academic year 1939–40. The amount of each award will be determined on the basis of the previous training, demonstrated competence and promise of the candidate as respects his chosen field of work. Except under unusual circumstances, the amount of the individual award will range between $1,800 and $2,500.

Seven fellowships of the 1938-39 series are being currently administered by the foundation, which was organized in 1935. The activities of the holders of present fellowship awards are in the fields of biochemistry, cryogenics, the chemistry of enzymes, photochemistry and macro-molecular chemistry, and the institutions at which the researches are being conducted are the University of Upsala, the University of Leipzig, Harvard University, the Johns Hopkins University, the Massachusetts Institute of Technology, the University of Chicago and the University of California.

The awards in the 1939–40 series will be given for fundamental research work in any of the various fields of chemistry. Support for industrial research or research in applied science is not intended. The awards are open to both men and women and can be used for work anywhere in the United States or abroad. Men and women in academic service who may be on sabbatical leave or other leave of absence are among those eligible for appointment. Attainment of the degree of Ph.D. or training equivalent thereto is a requirement for candidacy. There are no other limitations either as respects age or residence.

In approving the enlarged budget to cover this series of prospective awards, the board of trustees of the foundation has had in mind a somewhat more definite allocation than in the past of a portion of the funds available.

The official announcement points out that there is a growing appreciation of the intimate interrelationship that exists between chemistry and the modern science of medicine. In this country, there are only a few men who, by having both a thorough background in fundamental chemical research and a commensurately adequate experience in the biological and medical sciences, are qualified to accomplish the most important work in these fields and for whom the attainment of outstanding eminence is to be expected. Therefore, as respects a reasonable proportion of the Lalor awards to be granted, preference will be accorded to candidates shaping their careers or carrying on research to accomplish a more effective application of the principles and discoveries of physical and organic chemistry upon problems of biochemistry, chemotherapy and pharmacology. In the case of awards of such character, renewals of the grants for an additional year or longer will be favorably considered. Time to be spent in acquiring training in the medical studies necessary for a thorough understanding of the clinical aspects of these subjects will be considered acceptable as a part of the plan of work of the candidate.

The qualifications of candidates will be passed upon by a Selection Committee consisting of Drs. C. A. Kraus, of Brown University; Arthur B. Lamb, of Harvard University; Roger Adams, of the University of Illinois; Hans T. Clarke, of Columbia University, and the secretary of the foundation.

Inquiries and requests for application forms for awards should be addressed to C. Lalor Burdick, Secretary, Lalor Foundation, Wilmington, Delaware. Applications are to be in the hands of the secretary by December 15, and appointments will be announced early in March, 1939.

THE BEIT MEMORIAL TRUST FOR MEDICAL RESEARCH

A meeting of the trustees of the Beit Memorial Fellowships for Medical Research was held recently for the election of fellows and other business.

As reported in *The British Medical Journal* the total number of fellowships held by full-time workers during the year 1937–38 was twenty-three. The number of candidates at the present election was higher than usual. Five applied from Canada and three from

Australia. Reserve funds made it possible to award more junior fellowships than are ordinarily given each year, and the election of twelve new junior fellows brought the total number of those elected since the beginning of the trust in 1910 to exactly 200. A fresh edition has been printed this year of the Green Book, which summarizes briefly the after-careers of each fellow and their present position in research.

The following elections were made:

Senior Fellowship (value £700 a year).—David Ezra Green, to continue his research on the rôle of vitamin B_1 in the oxidation of pyruvic acid, and to study a new flavin-protein compound in milk (Institute of Biochemistry, University of Cambridge).

Fourth-Year Fellowship (value £500 a year).—Myer Head Salaman, to continue his research on vaccinia and animal pox viruses (Lister Institute of Preventive Medicine, London).

Junior Fellowships (normal value £400 a year).—Geoffrey Bourne, biochemist, Commonwealth Advisory Council on Nutrition, Sydney, N.S.W., 1937, the significance of vitamin C in the endocrine system (department of human anatomy, University of Oxford); Andrew Lawrence Chute, experimental studies in metabolism of the brain (department of physiology, University College, London); Robert Oswald Lennard Curry, the physiology of speech disorders by photographic study of laryngeal movements (University College, London); James Frederick Danielli, the permeability of normal and denervated muscle to metabolic products and to drugs (Institute of Biochemistry, University of Cambridge); John George Dewan, "insulin shock" treatment of schizophrenia by experimental studies of brain metabolism (Institute of Biochemistry, University of Cambridge); Catherine Olding Hebb, the effect of thoracic sympathectomy on the activities of the lung (department of physiology, University of Edinburgh); Bernhard Katz, electric excitation and transmission of impulses in nerve and muscle of animals (department of biophysics, University College, London); Jonas Henrik Kellgren, painful conditions of the limbs and back (department of clinical research, University College Hospital, London); John James Duncan King, dental caries and parodontal disease (Medical School, University of Sheffield); Hermann Lehmann, blood sugar in animals and iron metabolism in plants (Institute of Biochemistry, University of Cambridge); Walter John O'Connor, effect of strophanthin on the oxygen consumption of the heart (laboratory of pharmacology, University of Cambridge); Harold Scarborough, mode of destruction of vitamin C in the human body (clinical and chemical laboratories, Royal Infirmary, Edinburgh).

THE INDUSTRIAL RESEARCH INSTITUTE

CURRENT industrial research problems and progress being made in the laboratories in behalf of business were reviewed at the fall meeting of the Industrial Research Institute on September 23 and 24 at Rye, N. Y.

Maurice Holland is acting executive of the institute, which is an affiliate of the National Research Council. The membership is made up of research executives of American industries, who are attempting to put American industrial research on a more efficient business basis through surveys and other cooperative effort.

The program included reports on the progress of surveys now being conducted by the institute on the construction and control of research budgets, problems of personnel, organization and committee recommendations. Robert B. Colgate, of New York, vice-president in charge of research for the Colgate-Palmolive-Peet Company and chairman of the executive board of the institute, presided.

The institute was organized last May after a factual survey among leading scientific research men prominent in their respective fields of industry demonstrated both the need and the desire for a cooperative agency where common problems of laboratory organization, administration and direction could be discussed and attacked. Its headquarters are at the offices of the Division of Engineering and Industrial Research of the National Research Council at 29 West 39th Street, New York.

The executive committee of the institute held a discussion of future plans as well as reviews, preliminary reports and recommendations. The members of the executive committee are: H. W. Graham, general metallurgist, Jones and Laughlin Steel Corporation, Pittsburgh, who is *vice-chairman;* O. A. Pickett, research director, Hercules Powder Company, Wilmington, Del.; Donald Bradner, director of research and development, Champion Paper and Fibre Company, Hamilton, Ohio; H. Earl Hoover, vice-president, The Hoover Company, Chicago; J. M. Wells, vice-president, American Optical Company, Southbridge, Mass., and G. E. Hopkins, technical director, Bigelow-Sanford Carpet Company, Thompsonville, Conn.

DAMAGE SUFFERED BY THE ARNOLD ARBORETUM FROM THE HURRICANE

DR. ELMER D. MERRILL, professor of botany and administrator of the botanical collection of Harvard University and supervisor of the Arnold Arboretum, writes that in the late afternoon and early evening of September 21 the Boston area experienced its worst wind storm since weather records have been maintained. This was the West Indian hurricane that proceeded northward along the New England coast. The rainfall was relatively slight in Boston, but the wind velocities at times reached approximately (87 miles actually reported) 90 miles per hour. Dr. Merrill states that a velocity of 187 miles an hour was recorded at Blue Hill Observatory—10 miles southeast of the Arboretum—and that the velocity was certainly over 100 miles an hour at the Arboretum. He states that during twenty-two years spent in the Philippines, a region noted for its numerous destructive typhoons, he actually experienced higher wind velocities only two or three times. Naturally large property damage resulted, and literally hundreds of thousands of trees were uprooted or so badly damaged that they will have to be removed and replaced. The Arboretum suffered severely. The loss of species, however, was almost negligible, as younger plants survived. The following gives an account of the damage suffered:

> The storm was intense at 5: 00 P. M. and gradually increased in violence. The worst damage was done in the arboretum between about 5: 30 P. M. and 6: 30 P. M. A tour of the grounds at 5: 30 P. M. revealed relatively slight damage; for example there were only three or four trees in the extensive pine grove back of the administration building that were down or showed signs of weakening at that time; an hour later nearly all the trees in the entire planting were prostrate. The sound of rustling leaves, breaking branches, and creaking trunks was at times almost deafening. The worst of the storm was over by 8: 00 P. M.
>
> A hurried survey made early the next morning showed that approximately 1,500 trees were either uprooted, broken off, or their tops so badly damaged that they will have to be removed. Many others were injured, but can be saved by judicious pruning. The losses include some of the oldest and largest trees in the arboretum, as well as some of the rarest ones. Some of the roads were impassable, and all paths and roads were strewn with debris, broken branches, and fallen trunks. Damage was particularly serious in certain exposed areas, notably on the slopes back of the administration building, on the southeast or exposed side of hemlock hill, where scores of century old native hemlocks fell, in the southern part of the pinetum, where many of the largest pines, firs, and spruces are prostrate, and along the southeast side of the Peters hill area, particularly in the collections of poplars and oaks.

SCIENTIFIC NOTES AND NEWS

THE American Society of Mechanical Engineers announces the election to the presidency of the society on September 27 of Professor Alexander G. Christie, of the Johns Hopkins University. He will assume office on December 9.

DR. WILLIAM S. MIDDLETON, dean of the Medical School of the University of Wisconsin, has received the award of the council of the Wisconsin State Medical Society. The inscription on the award reads in part: "A son of Pennsylvania, twenty-six years an educator of physicians and now dean of the University of Wisconsin Medical School, distinguished consultant and clinician, deviser of the council on scientific work of the State Medical Society of Wisconsin, for your accomplishments and lofty inspiration in the teaching of students and practitioners, for your quarter of a century of public service, and for your outstanding influence in the development of a high quality of medical service for the citizenry of Wisconsin."

ACCORDING to *Nature*, Dr. Hermann Fink, professor of the biochemistry and technology of fermentation in the University of Basle, has been awarded the Scheele Medal of the Stockholm Chemical Society.

H. W. DICKINSON, of London, a founder and past president of the Newcomen Society of England and for thirty years one of the heads of the Science Museum at South Kensington, was the guest of honor at a reception held at the New York Museum of Science and Industry on September 28. The gathering followed an informal dinner tendered Mr. Dickinson by the American branch of the Newcomen Society. The speakers included Dr. Frank B. Jewett, president of the museum; Charles Penrose, senior vice-president of the American branch of the Newcomen Society, and Mr. Dickinson.

DR. REINHOLD RUEDENBERG, consulting engineer of the General Electric Company, Inc., in London, has been appointed Gordon-McKay professor of electrical engineering at Harvard University, and Dr. John Everett Gordon, of Chicago, field director of the International Health Division of the Rockefeller Foundation, has been appointed professor of preventive medicine and epidemiology in the Medical School.

DR. VIKTOR FRANCIS HESS, formerly professor of experimental physics at the University of Innsbruck, who in 1936 shared a Nobel Prize for his work on cosmic rays with Dr. Carl David Anderson, of the California Institute of Technology, has joined the faculty of Fordham University.

AT Radcliffe College, Harvard University, Dr. William F. Ross, research associate of organic chemistry at the Massachusetts Institute of Technology, has been appointed resident director of the laboratories of chemistry, and Dr. M. Gene Black has been appointed director of the department of health education.

IN the College of Medicine of the University of Vermont, Dr. Harold B. Pierce has been appointed head of the department of biochemistry and acting head of the department of pharmacology, and Dr. John E. Davis has been appointed instructor in pharmacology and biochemistry.

PROFESSOR FRED E. FOSS, head of the department of civil engineering at Cooper Union, New York City, retired at his own request at the end of the last academic year. Ray C. Brumfield, assistant professor of civil engineering, has been appointed acting head of the department for 1938–39.

Dr. Neil E. Rigler, of the North Carolina Agricultural Experiment Station, has been appointed plant physiologist in the division of plant pathology and physiology of the Texas Agricultural Experiment Station, College Station.

Dr. E. C. Ogden, of the Gray Herbarium of Harvard University, has been appointed instructor in botany at the University of Maine.

At the University of Cambridge, Dr. A. J. Bradley has been appointed assistant director of research in crystallography, and Dr. J. E. Driver has been appointed university demonstrator in the department of chemistry.

The board of directors of the Herty Foundation has appointed Frank Heyward, Jr., state forester, field director, and Dr. Charles H. Carpenter, technical director, to carry on the work in pulp wood development of the late Dr. Charles H. Herty at Savannah. Mr. Heyward has leave of absence from the State Forestry Department to accept the acting field directorship of the foundation. Dr. Carpenter, chief chemist of the Herty Foundation Laboratory, has served as executive director since Dr. Herty's death.

William Hudson Behney, assistant professor of zoology at the University of Vermont, has been given leave of absence to become director of the State Fish and Game Service, where he succeeds Dr. Russell P. Hunter, who resigned recently in order to accept a similar position in Connecticut.

At the Field Museum of Natural History, Dr. Francis Drouet has been appointed a member of the department of botany. He will have charge of the collections of cryptogamic plants. Bryan Patterson, assistant curator of paleontology, has returned to the museum after spending several months in Europe, making studies of fossil mammal collections in the Museum national d'Histoire naturelle in Paris and in the British Museum (Natural History) in London. Dr. Julian A. Steyermark, assistant curator of the herbarium, has returned from a collecting trip, during which a botanical survey was made of the flora of the St. Francis River in Wayne County, Missouri. Dr. C. E. Hellmayr, associate curator of birds, who for some years has been in Vienna, where he has been working on the preparation of the "Catalogue of Birds of the Americas," is now in London, where he moved on account of political conditions in central Europe.

Dr. George E. Barker has been appointed incumbent of the industrial fellowship established at the Mellon Institute by the Elgin National Watch Company, Elgin, Ill. The research program will cover broadly the chemical aspects of technical problems in the watch industry. One of the first subjects of investigation will be watch lubrication.

Dr. Erma A. Smith, associate professor of physiology in the Iowa State College, has been allotted a grant by the Committee on Research of the American Medical Association to be used in a study of the effects of carbon monoxide gas on gastro-intestinal motility.

Ellsworth McSweeney has become a research associate at Battelle Memorial Institute, Columbus, and is beginning a study of organic tin compounds, one of several fundamental research projects financed by the institute.

Professor E. Loewenstein, formerly of Vienna, known for his investigations on the immunology and bacteriology of tuberculosis, has taken up work at the University of California.

Dr. Alfred C. Reed, professor of tropical medicine in the University of California, is at present in Europe. He planned to visit a number of hospitals in London and to go to Beirut, Damascus, Jerusalem, Cairo, Rhodes, Athens, Italy, France, Stockholm, Copenhagen and Holland. He is president-elect of the American Society of Tropical Medicine, which will meet in Oklahoma City from November 14 to 17.

Dr. Walter Carter, of the Pineapple Experiment Station, Honolulu, returned recently after an eleven-month tour of the pineapple areas in *Africa*, Malaya, Dutch East Indies, Philippine Islands, Australia and Fiji.

A. H. G. Alston, an assistant keeper in the department of botany of the British Museum (Natural History), plans to visit Trinidad and then to travel across Venezuela and Colombia to Buenaventura, collecting plants for the museum and studying the ferns of northern South America. He expects to be away for about seven months. On his way he will attend the first South American Botanical Assembly, which will be held at Rio de Janeiro from October 12 to 19.

In connection with the recent allotment of funds to the Geological Survey by the Public Works Administration for a study of strategic metals, D. F. Hewett spent the latter part of August in examining tin prospects and possibilities in the vicinity of Tinton and Keystone, S. Dak.

Professor Jules Drach, of the University of Paris, in attendance as the representative of the Paris Academy of Sciences at the fifth Congress of Applied Mechanics recently held at the Massachusetts Institute of Technology, delivered a course of four lectures from September 22 to 26 on "The Logical Integration of Differential Equations, with Applications to the Equations of Geometry and of Mechanics," at the Rice Institute.

LECTURES will be given at the University of Buffalo under the Foster Fund by Professor E. M. K. Geiling, of the University of Chicago, at the end of October on "Recent Trends in Endocrinology" and on "Some Biological Adaptations of the Whale," and during the week of November 7 by Professor M. S. Kharasch, also of the University of Chicago, on the general subject, "Chain Reactions Involving Atoms and Free Radicals in Solution." The Foster Fund was given to the university by Mrs. Orin D. Foster, in memory of her husband, to endow a lectureship in chemistry and related fields. Mr. and Mrs. Foster also gave the university Foster Hall, which houses the department of chemistry and the School of Pharmacy.

SIR WILLIAM BRAGG, president of the Royal Society, opened the Sir Robert Hadfield Metallurgical Laboratories of the department of applied science of the University of Sheffield on September 14. The new extensions and improvements, which were built at a cost of £30,000, represent the first stage in a plan of development for which an appeal for £250,000 was made two years ago. Sir Robert Hadfield, chairman and managing director of Hadfield's, Limited, Sheffield, gave £10,000 of the £30,000 required and equipped one of the research laboratories at a cost of £2,000. He also gave £5,000 for the plans for the new foundation.

THE Academy of Medicine of Washington, D. C., held its first autumn meeting on September 28. Dr. Philip Manson-Bahr, clinical director of the London School of Tropical Medicine, gave an address on "The Life and Works of Patrick Manson, Father of Tropical Medicine." Dr. Manson-Bahr is the author of a life of Sir Patrick Manson. The academy met this fall without one of its members, lost in the Hawaiian Clipper tragedy of July the twenty-ninth. Dr. Earl Baldwin McKinley was the moving spirit in the founding of the academy. Dr. Harry H. Donnally addressed the academy in tribute to Dr. McKinley.

THE Cotton States Branch of the American Association of Economic Entomologists will hold its 1939 annual meeting on February 21, 22 and 23, 1939, at Tampa, Fla. The Hillsboro Hotel has been selected as headquarters, where special rates of from $2.50 up have been obtained for delegates. Due to the overcrowded condition of Florida cities during the tourist season, reservations should be placed early by those who expect to attend.

A MISSOURI Minerals Industry Conference, sponsored by the Missouri School of Mines and Metallurgy and the Missouri Geological Survey, will be held at the School of Mines on October 21 and 22. The object of the conference, according to Dr. William R. Chedsey, director of the School of Mines, is for the mutual benefit of the producers of mineral products and the service institutions that are supported by the states. It will take the form of the presentation of problems of the various mineral industries by mineral producers. Dr. H. A. Buehler, of the Missouri Geological Survey; S. M. Shelton, supervising engineer of the Mississippi Valley Experiment Station of the U. S. Bureau of Mines, and Dr. Chedsey will outline the services that are now available to the producers of minerals in Missouri.

THE Society for the Promotion of Engineering Education will hold its annual convention in 1940 at the University of California in Berkeley.

FELLOWSHIPS in the Medical Sciences, administered by the Medical Fellowship Board of the National Research Council, of which Dr. Francis G. Blake, of Yale University, is chairman, will be available for the year beginning July 1, 1939. These fellowships are open to citizens of the United States and Canada who possess an M.D. or a Ph.D. degree. They are intended for recent graduates and not for persons already professionally established. Fellows will be appointed at a meeting of the board about March 1. Applications to receive consideration at this meeting must be filed on or before January 1. Appointments may begin on any date determined by the board. For further particulars address the Secretary of the Medical Fellowship Board, National Research Council, 2101 Constitution Avenue, Washington, D. C.

DISCUSSION

WAR AND SCIENCE

FOR a number of months European civilization has been making history around sharp curves at high and rapidly increasing speed. With brakes ineffective and accelerators pushed down to the floor, on September 14 it appeared to be crashing through the guards and about to plunge into the abyss of another world war. Then something happened, something unparalleled in the history of the world. It began to respond to control and changed its course to a smoother and safer road.

There were undoubtedly many factors that restrained Herr Hitler from precipitating Europe into war. In spite of his 10,000 airplanes and Germany's capacity for producing more, he may have feared the ultimate strangling effects of his opponents' control of the sea. Perhaps he remembered that Italy had an army in Ethiopia and another in Spain and a long coast that it could not easily defend. Perhaps the announced intention of France and Russia and Great Britain to defend Czechoslovakia against aggression sounded in his ears like the rumble of a distant storm. He may have had a normal human reaction from the frenzy of his radio address to Germany. In spite of his harsh and uncompromising words, he may have heard an inner voice that warned him against arbitrarily condemning millions of young men to death. The dramatic visits and appeals of Mr. Chamberlain may have pleased his vanity and softened his heart. The intercessions of the President of the United States may have inclined him to a magnanimous gesture appropriate to a conqueror. All these things and many more may have had their effects.

The supreme influence, however, was the radio address of an elderly gentleman to his countrymen and to the remainder of civilized mankind. In it there was no boasting of irresistible might and preparations for war; no attacks on enemies, real or manufactured for the occasion; no claims of great achievements or promises of them in the future. In simplicity and humility Mr. Chamberlain explained what had happened and the steps that he had taken in his attempts to avoid open conflicts. He described the sacrifices Czechoslovakia had agreed to suffer in the interests of peace. He frankly expressed his fears of the horrors of war. With infinite restraint and consideration for the opinions of others, he made his nearest approach to being critical in his simple statement that he thought a certain position of Herr Hitler was unreasonable. After the seven minutes of Mr. Chamberlain's address, ranting and screaming and defying their enemies will no longer seem appropriate for statesmen in Great Britain or in Europe or in America.

There have been many turning points in history, most of them marked by great battles. One was when the Greek phalanxes at Marathon pierced the ranks of the Persian hordes and threw them into confusion. One was when Charles Martel and his army turned back the Saracens at Tours. One was when the allied forces shattered the power of Napoleon at Waterloo. And probably a more important turning point in human history than any of these was the radio address of Mr. Chamberlain, which was, of course, only the climax of a series of dramatic events. Like a mysterious voice coming through the ether from another world, it plead for tolerance, cooperation and the rule of reason. It aroused the better nature of mankind. Mothers in England and France and Germany and Italy and Czechoslovakia were happier that night than they had been for months. A cloud was being raised, a new light was shining, and peace in Europe was in the making.

An essential difference between the recent dramatic events in Europe and previous turning points in history is that in this crisis the opinions of the masses were an important influence. This was certainly true in democratic England. It was true even in Germany. The cheers of the Germans for Mr. Chamberlain, a potential enemy but on a peace mission, can not have escaped Herr Hitler. The visits of Mr. Chamberlain and his broadcasts, which were carried throughout Germany, had more profound effects than the winning or the losing of a battle. For many years, during which international relations will probably be established on a new basis, the words of Mr. Chamberlain and his visits to Germany and the final compromise of the interested parties will be cherished memories.

These dramatic and gloriously hopeful pages of human history could not have been written without the miraculous means of transportation and communication provided by science. Too often science has been charged with being largely responsible for the evils of mankind and with adding greatly to the horrors of war. In his presidential address before the British Association for the Advancement of Science, Lord Rayleigh refuted those charges. Perhaps a better refutation would be a proof that wars have not become more terrible with the advance of science. No one who has read of the siege of Jerusalem or of the Crusades or of the Thirty Years War in Germany would maintain such a position. All wars have caused deaths and disease and unhealed wounds and starvation and endless suffering. Science has saved more human life in the past ten years than was destroyed during the world war. Science can easily establish the fact that the sum total of its effects has been to relieve suffering and save life. And just now its applications have been an essential factor in initiating a new period in human history.

It would be naïve to assume that the agreements reached at Munich were not based in part on national jockeying for position. It would be even more naïve to believe that human hearts have suddenly become generous and altruistic. No such miracle has happened or will happen for a geologic age. It is true that Czechoslovakia is being dismembered and Russia is ignored. Already dictators are strutting as the saviors of peace. But the masses feel that they have been consulted, that town meetings have been held on a national scale. For at least a generation it will not be easy for Europe to become involved in a general war without the approval of the humble citizens who would suffer because of it. The pattern of negotiation and compromise has been set, and the power of a moral principle is again stirring mankind.

What has all this to do with scientists? Only to remind them that they face an opportunity. For years they have cultivated cordial international relationships among themselves. As I have already written elsewhere, science is wholly independent of national boundaries and races and creeds. This is no idle statement. It is a living reality, illustrated in the international congresses of scientists that are being held in large numbers. Last December the American Association for the Advancement of Science passed a resolution calling on the British Association for the Advancement of Science and "all other scientific organizations throughout the world to cooperate not only in advancing the interests of science but also in promoting peace among nations and intellectual freedom in order that science may continue to advance and to spread more abundantly its benefits to all mankind."

At its recent meeting the British Association passed resolutions for closer cooperation with the American Association and organized a division for exploring the interrelations of science and society. The American Association will not neglect its opportunities to make science and the generous ideals of science more important factors in the progress of society. Its age and honorable history, its broad interests, which include not only the natural sciences but the humanities, its large and rapidly increasing membership, its obligations to society and its unparalleled opportunity to be of service to mankind all inspire its membership.

F. R. Moulton

Office of the Permanent Secretary
of the American Association for
the Advancement of Science

THE WESTINGHOUSE TIME CAPSULE

So many readers of Science and others have shown interest in the questions propounded in my letter published August 19 that a brief explanation of how these problems were finally settled may be in order. I wrote that Westinghouse was desirous of depositing a "Time Capsule" on the site of the New York World's Fair, containing a "cross section of our time" for posterity 5,000 years from now.

The problem contains three major parts: (1) how to build a vessel capable of lasting 5,000 years, (2) how to leave word of its whereabouts for historians of the future and (3) the selection and preservation of the contents. There are many subsidiary problems, such as protection of the deposit against vandalism. Burial 50 feet deep in the swampy soil of the fair site is expected to take care of this latter problem quite effectively.

The construction of the vessel was undertaken by a committee headed by M. W. Smith, Westinghouse manager of engineering. It was decided that a hard alloy of copper would be most suitable. For reasons of strength and convenience, a torpedo shape was chosen. The Time Capsule, as finally constructed, is seven and a half feet long and eight and three eighths inches in diameter. The outer shell consists of seven cast segments of Cupaloy (copper 99.4 per cent., chromium .5 per cent., silver .1 per cent.) which is temperable to the hardness of mild steel, but has corrosion resistance and electrical characteristics similar to those of pure copper. The segments are screwed together hard and sealed with asphalt; the nearly invisible joints peened out and the outer surface burnished.

The inner crypt, six and a half inches in diameter and six feet nine inches long, is lined with an envelope of Pyrex glass, set in a water-repellent petroleum base wax. This crypt, evacuated, washed and filled with slightly humid nitrogen, contains the "cross-section of our time."

After consultation with librarians, museum authorities and the U. S. Bureau of Standards, it was decided to leave word for the future by means of a book, printed on permanent paper in special inks. In order that the appearance of this "Book of Record of the Time Capsule" might match its permanence, Frederic W. Goudy consented to design it and set a portion of the type. A special run of 100-pound book paper was made to Bureau of Standards specifications. Suggestions for binding and general treatment were obtained from the National Archives, the New York Public Library and other sources. The cover is royal blue buckram stamped in genuine gold. The signatures are sewed by hand with linen thread.

Copies of this book will be sent to selected libraries, museums and other repositories throughout the world, in the hope that a few will survive in some form for the required time. The book contains a message asking that it be preserved and translated into new languages as they appear; a description of the Capsule's contents, and the exact latitude and longitude of the deposit as determined by the U. S. Coast and Geodetic Survey to the third decimal point in seconds. The geodetic coordinates are tied into the survey's national network, on which astronomical as well as geodetic data are given. In addition, instructions are included for making and using instruments to locate the Time Capsule by the methods of electromagnetic prospecting.

That our tongue may be preserved, the book contains an ingenious "Key to the English Language," devised by Dr. John P. Harrington, of the Smithsonian Institution. By means of simple diagrams, the peculiarities of English grammar are explained; a mouth map shows how each of the 33 sounds of English are pronounced. A 1,000-word vocabulary of "High Frequency English," spelled in the ordinary way and neophonetically, is provided. In itself the key is believed to contain all the elements archeologists of the future will need to translate and pronounce 1938 English, but to make doubly certain, the Time Capsule itself contains multilingual texts, a dictionary and a lexicon of slang and colloquial English.

The third problem, choosing the Capsule's contents, proved the most difficult. It is inconceivable that any selection short of a most voluminous burial could adequately represent all the enormous variety and vigor of our contemporary scene. In making our selection we consulted archeologists, historians, authorities in art and literature, editors and many others. Out of thousands of suggestions, we finally chose to include some thirty-five articles of common use, ranging from a slide rule to a woman's hat, each selected for what it might reveal about us in the archeological sense. About seventy-five samples of common materials are included, ranging from fabrics of various kinds, metals, alloys, plastics and synthetics to a lump of anthracite and a dozen kinds of common seeds.

These material items, however, are only supplementary to a voluminous essay about us and our times, reduced to microfilm. On three and a half small reels there are reproduced books, articles, magazines, newspapers, reports, circulars, catalogs, pictures; discussing in logical order where we live and work, our arts and entertainment, how information is disseminated among us, our general information, our religions and philosophies, our education and educational systems, our sciences and techniques, our earth, its features and peoples; medicine, public health, dentistry and pharmacy, our major industries and other subjects. This "Micro-file" comprises more than 22,000 pages of text and 1,000 pictures; a total of more than 10,000,000 words. It includes instructions for making, among other things, a motion picture projection machine. For use with this are three spools of newsreel, made up especially by RKO-Pathe Pictures, Inc., showing about twenty characteristic significant or historical scenes of our times, complete with sound. A magnifier is, of course, included for reading the microfilm. Instructions are provided for making a full-size reading machine.

This task of leaving word of our time for "futurians" has been undertaken with a deep sense of our responsibility. It could never have been done were it not for the willing help of many men of science, hundreds of whom have made valuable suggestions, or given time and thought to the details of the venture. Space does not permit naming many of them here, but I can not forbear mention of Dr. Clark Wissler, of the American Museum of Natural History, whose guidance throughout has been most valuable.

Further details of the Time Capsule project will be reported fully elsewhere. Complete lists of the contents and other information will be sent to any one interested. It is hoped that this pioneer effort will encourage others to deposit even more adequate records of our day in many places, and at such intervals as will provide "futurians" with a complete running history of their past, our present.

David S. Youngholm,
Vice-President, Westinghouse Electric and Manufacturing Company

THE SALARIES OF MEN OF SCIENCE EMPLOYED IN INDUSTRY

In connection with an investigation of the pecuniary rewards of great abilities, I have obtained the facts for the starred men in the Cattell list of 1935 who were employed by business concerns.

There were seventy-two such men. Twenty-seven of them were employed by companies not listed in the Treasury report to the Ways and Means Committee. Of the others, twenty-nine presumably received less than $15,000 per year, inasmuch as their salaries are not reported. But a few may have been on leave of absence or not included by some error. This leaves sixteen receiving $15,000 or over as shown below, with the persons' reported fields of research:

$15,000 to $19,999	4	(chemistry, optics, physics, psychology)
20,000 to 24,999	2	(chemistry for both)
25,000 to 29,999	4	(chemistry for three; electrical engineering)
30,000 to 34,000	1	(chemistry)
35,000 to 39,999		
40,000 to 44,999	1	(chemical engineering)
45,000 to 49,999		
50,000 to 54,999	1	(photography)
55,000 to 59,999	1	(physics and electrical engineering)
60,000 to 64,999		
65,000 to 69,999	1	(chemistry)
70,000 to 74,999	1	(chemistry)

I estimate that ten of the twenty-nine men in these companies received $10,000 to $14,999 and nineteen of them $5,000 to $9,999.

Most of the men receiving over $15,000 have managerial responsibilities. But some of them are nearly or quite as free as they would be if employed by universities or philanthropic institutions. I think, however, that $21,500 is the highest of the salaries paid for work under such conditions. The man receiving it has managerial responsibilities, but perhaps no more unpleasant or distracting than those of the head of a university department or laboratory for pure research.

E. L. Thorndike

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SCIENTIFIC BOOKS

THE TSETSE FLIES OF EAST AFRICA

The Tsetse Flies of East Africa. A First Study of their Ecology, with a view to their Control. By C. F. M. SWYNNERTON. With a preface by the Right Hon. W. Ormsby-Gore, M.P. Trans. Royal Entomological Society of London, Vol. 84, pp. xxxvi + 579, frontispiece, 22 pls., 7 folded maps, 33 figs. in text. November, 1936. £5-10-0.

THE recent tragic death of Mr. C. F. M. Swynnerton in an aeroplane accident recalls the fact that he had introduced aerial inspection and photography in his work as director of the Tsetse Research Department of Tanganyika Territory with a view to mapping the forest and plant associations. These ecological associations of the African vegetation play a major part in determining the location, abundance, breeding, feeding and pupation areas of the seven species of tsetse flies which infest this territory. The "fly" in turn plays a dominating role in the human culture here and elsewhere in tropical Africa from Senegal and the Sudan to southern Rhodesia.

In Tanganyika the eight species of tsetse fly, the several species of the blood-parasitizing trypanosomes of which they are in varying host-parasite relations, the insect vectors, men, cattle, the host of African game mammals, birds, crocodiles, snakes, and lizards in whose bloods the trypanosomes are variously multiplied and on whose bloods the fly selectively to some extent and often by reason of hunger feeds, the grasslands and varied bush, forest and jungle, the streams and lakes, and the changing season all combine in an ecological picture of great complexity and ceaseless changes. Man enters the picture as the victim of both the Rhodesian trypanosome and *Trypanosoma gambiense,* causes of the fatal African sleeping sickness. His domesticated animals also fall victims to other trypanosome infections, notably nagana, the fatal disease of cattle. His movements and those of his cattle attract the flies and spread these vectors and the disease-producing flagellates into new territories. He clears the forest, burns the grasslands and changes the habitats of the flies and the wild game whose bloods constitute an unfailing reservoir infected by trypanosomes or ready to be infected at birth or even before birth across the placenta from the infected mother. He abandons fly-infested regions, crowds his herds into narrower confines, and the resulting overgrazing leads to destruction of the plant cover. Soil erosion then permanently ruins the region. In recent years the fly has been steadily advancing into hitherto fly-free regions in Tanganyika with resulting havoc to the native people and their settlements and herds.

It was Swynnerton's task to discover means of practical control of vital factors in this complicated picture or of local parts of it which would save both the livelihood and the lives of these pastoral and agricultural tribes. It was not a swivel chair job for testing out naturalists' haphazard guesses but one of tragic necessity on the one hand and limited knowledge and resources on the other.

This condensed abbreviated report is rightly designated as an ecology. Its object has been to find weak links in the chain of relations between the hosts and the insect vectors of trypanosome infections. To this end the natural history of the eight species of tsetse fly in the region was thoroughly investigated as to the plant communities of its vegetational habitat, the feeding grounds, the rest-haunt and the breeding ground and their respective furnitures. The environmental factors, altitudinal, geological, climatic, soil, humidity, temperature and vegetation were also analyzed and mapped or recorded. The geographical and local habitat distribution was worked out by quantitative and statistical methods based in part on systematic fly catching by trained native boys, trapping with a great variety of traps and baits, and records of sexes, weights in relation to hunger, feeding, age and breeding, and seasonal and other changes in the fly population. Since the female tsetse fly feeds with reference to reproduction and develops only a single egg at a time, depositing this in the pupa stage in damp surroundings, these statistical investigations have a direct bearing on many aspects of the problems studied. The complexity of the situation is increased by the fact that each species has its own distinct pattern of life not transferable by analogy or inference to another species.

The wild game animals play a large role in the tsetse drama. The flies follow moving animals; hence game forms not merely a reservoir of infections but active vehicles in transportation along forest trails and to and from waterholes in the dry season and across natural and artificial barriers. Experimental evidence shows that sight guides flies to their moving hosts and that a road to be safeguarded from flies from the adjacent bush must have at least 200 and preferably 500 yards on either side cleared of fly cover. Scent comes into action at shorter distances. Mammalian glands were effectively used in baiting traps. Scent seems to guide flies to favored species, and sex of host or even to favored individuals. The author places little confidence in game extermination in fly control, as impracticable because of reinvasion, difficulties in accomplishment and unreliability in a partially settled country.

This report is itself a summary, and a review must be wholly inadequate in presenting the riches of experiment in laboratory and field, and the extraordinarily diverse aspects of the problems discovered and attacked. Certain practical results are enumerated and lines of endeavor in control tested and judged in the light of results. A few of the significant conclusions are as follows: Each species of fly and each biotic area must be studied in detail before control measures should be undertaken. In studying the problems each suggestion arising from observations in the field was examined as to its feasibility, practicability, difficulties, cost and effectiveness, tested in the laboratory and on a small scale in the field, and then on a control basis. As a results of such studies recommendations are made for cessation of annual burning of the bush by the cattle-grazing natives, the building up of fly barriers by native bush, preferably evergreen, which are traversed slowly if at all by the fly, clearness of infested fly territory by native settlement, control of plant associations and methodical trapping of flies of certain species in certain territories till they are so reduced in numbers that human occupation can continue. Roads through fly country can be made safe by clearing, and fly concentrations can be isolated in like manner. In general the author favors policies of control by knowledge of the ecological factors most accessible to economical change and most potent in each ecologic niche in reducing the mass of the tsetse menace below the level of human disaster. Extermination is out of the question. Even then the enormousness of the task for tropical Africa is appalling.

As an example of practical ecological investigation and resulting control measures this investigation is outstanding in its magnitude, scope and accomplishments. It is a far-sighted, wide-visioned and skilfully operated attack upon one of the most tragic, complex, intricate and perplexing problems in parasitic ecology facing human civilization in a great continent.

One encouraging feature is the tribute paid to native helpers for their industry, faithfulness and inventiveness in attacking these problems.

Charles A. Kofoid

TELEVISION

Electron Optics in Television. By I. G. Maloff and D. W. Epstein. McGraw-Hill Book Company.

Whereas it might seem that electron optics in television was a rather specialized subject, of interest to communication engineers rather than to physicists, the book is of somewhat broader scope than is indicated by its title.

In the first 40 pages of introduction, the authors give a good review of current cathode ray television technique, with particular emphasis on various scanning and viewing devices. They then develop the subject of electron optics. First they consider the emission of electrons from various sources. The treatment is clear, and this portion of the book might form a useful text for teaching. The next subject to be considered is the analogy between electron optics and light. There follows a detailed treatment of electron optics, covering the trajectories of electrons in fields of various geometries. Electrostatic lenses and the defects and aberrations which these show are discussed at some length, as well as the techniques used to overcome these errors.

Then, deflection of electrons in magnetic fields and various types of magnetostatic lenses and focussing are described. This discussion of electron optics is unusually complete, and will, no doubt, be of value to all physicists dealing with electronic or molecular beams, be they in mass spectrographs, cyclotrons or Van de Graaf generators.

The second portion of the book deals with the television cathode ray tube itself. First, the electron gun is described, and the deflection of the beam, the types of luminescent screens and various ratings and classes of tubes. Finally various accessories are explained, most of which are circuits for special purposes, such as relaxation oscillators, impulse generators, multivibrators and driving circuits. The final chapter will seem to many physicists to be a rather elementary discussion of vacuum technique. The second portion of the book is more specialized and perhaps not of as great interest to physicists generally as the first. Throughout, the figures are clear, and the book will make a useful addition to a physics library.

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REPORTS

THE RESEARCH COUNCIL ON PROBLEMS OF ALCOHOL[1]

The American Association for the Advancement of Science, through its permanent secretary, Dr. F. R. Moulton, made on October 3 the first public announcement of a new approach to the liquor problem through the launching of an associated organization known as the Research Council on Problems of Alcohol, the present membership of which includes nearly 100 distinguished scientists and educators from various sections of the country, as well as a group of citizens prominent in public and industrial life. The plan of the council, it is stated, is to make a "thorough, unbiased and strictly scientific investigation of the problems related to the control of alcoholic beverages and to seek solutions through a program of unprejudiced research and education." Dr. Moulton stated that this program is regarded as ranking in importance with the symposia sponsored by the association on such problems of public health as cancer, tuberculosis, leprosy, syphilis and mental health.

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[1] Press release from the office of the permanent secretary of the American Association for the Advancement of Science.

Dr. Karl M. Bowman, director of psychiatry at Bellevue Hospital and professor of psychiatry in New York University, is chairman of the fifteen-man executive committee, of which ten are required to be scientists. Dr. Hans T. Clarke, professor of biochemistry, Columbia University, is chairman of the scientific committee, while Willard E. Givens, executive secretary of the National Education Association, has been elected chairman of the educational committee. Dr. Moulton is secretary. Other executive committee appointments are: Dr. Luther Gulick, professor of government, Columbia University, and director of the Institute of Public Administration; Austin H. MacCormick, commissioner of correction of the City of New York; Dr. Nolan D. C. Lewis, professor of psychiatry at Columbia University; Dr. Winfred Overholser, superintendent, Saint Elizabeth's Hospital in Washington, D. C.; Dr. A. T. Poffenberger, professor of psychology at Columbia, and Albert W. Whitney, consulting director, National Conservation Bureau.

Dr. Harry H. Moore, formerly director of the Committee on the Costs of Medical Care and public health sociologist in the United States Public Health Service, has been chosen as director of the council's activities, with headquarters in New York.

Dr. Moulton emphasized "the extreme care with which the membership of the council had been limited, during its twelve-month organization period, to outstanding scientists and educators who are acknowledged leaders in their various fields." Members of the executive committee of the American Association for the Advancement of Science are *ex-officio* members of the council, including the present president, Dr. Wesley C. Mitchell, professor of economics at Columbia University, well known as a social scientist. The closeness of the tie-up of the Research Council to the association is evidenced by the provision that all funds of the council shall be administered and disbursed by the association.

Details of a 21-page outline of the program were outlined by Dr. Bowman. They included a six-point premise, of which the highlights were as follows:

> Prohibition was not successful. A large army of law enforcement officers with funds totalling many millions of dollars was not able, from 1920 to 1933, to prohibit the sale and use of alcoholic beverages. Repeal has not been successful. Excesses and abuses are evident to all. Under both prohibition and repeal, alcoholic beverages, when used unwisely, have caused inefficiency, disease and death.
>
> At least two specific evils are recognized both by the ''wets'' and ''drys.'' These are alcoholism and highway accidents due to the use of alcohol. In respect to many other aspects of the alcohol problem, there is a chaos of opinion. There is danger of hasty and unwarranted decisions in respect to the legal control of the liquor business.

The outline refers to the solution of the alcohol problem as one of the major perplexities of our civilization. It continues:

> On top of all the intrinsic difficulties of the situation, there have been superimposed emotional and political elements that have produced still further complications.
>
> It has become evident that nothing can be accomplished by the *application of main force*. If we are to find a way out, it can be only through the development of a complete factual basis on which can be built some effective plan of action. The main and primary objective of the Research Council on Problems of Alcohol is the development of such facts; the secondary objective is to make these facts available to the public in such a way that they will do the most good. Since the development of facts is essentially a scientific procedure, the personnel of the Council will be predominantly made up of persons who are working in the field of science. To these will be added such others from the fields of education, business and public life as will be able to assist in carrying out the secondary objective.
>
> What does science say about abstinence and prohibition? Here are two controversial questions which make the task of any agency dealing with them an extremely difficult one. In such a situation society is fortunate if it can turn to the scientist. The scientific attack on the problem of alcohol here outlined does not imply a commitment on the part of the scientist, or of any one else, to either the present ''wet'' or ''dry'' position. The scientist believes that if an adequate body of factual data is made available and discussed fully, without heat or prejudice by men and women of intelligence, integrity and leadership, the right solution of these two questions may then be evolved. Whether truth, as revealed by science, points the way to abstinence for the individual and prohibition for society, or to moderation for the individual and to some other form of control for society, or to a modification or combination of one or more of these policies, it will be the right solution for the time and place in which we live.

Briefly summed up, the Research Council defines its field of action in the following platform:

> The Council will conduct research, arrive at conclusions based on research, present the facts in suitable form to interested groups, and encourage intelligent discussion of the facts.
>
> The Council will not arrive at conclusions based on assumptions or prejudiced opinion, engage in propa-

> ganda, lobby for liquor control laws, or participate in political campaigns.

Enlarging on the above definition, the program continues:

> In attacking the problem of alcohol, there are three stages—research, education and control. While present conditions are unsatisfactory to all interests, and while many persons would like to "do something" about the problem at once, science says that to proceed without a sufficient body of factual material might lead to grave mistakes.
>
> A well-organized body of facts is needed in regard to (a) the effects of alcohol on the individual, (b) the effects of alcohol on society and (c) the effectiveness of various measures of industrial and legal control which have been attempted or which may be proposed. When the facts have been ascertained, through research, two kinds of remedial measures may then be developed—educational measures and measures of control.
>
> Education as to the effects of alcoholic beverages on the individual and on society is approved by both wets and drys. It must be carried on among both young people and adults. With the enactment of prohibition, in most communities education about alcohol practically stopped. Propaganda—both wet and dry—took the place of education. Now education must be strictly scientific; instruction must be given without prejudice, emotion or moralizing. Law enactment and law enforcement agencies need scientific knowledge regarding all aspects of the problem. Such knowledge obviously is essential to the development of effective governmental controls.
>
> As to measures of control, when the biological facts about alcoholic beverages are ascertained and disseminated among the people, they will then be in a better position, as individuals, to exercise self-control. When all the facts, biological and sociological, are placed before the various agencies responsible for the social control of the liquor business, society may then be more justified than it has been in the past in expecting them to develop effective industrial and legal controls.

That the results of data secured to date by previous scientific research will not be overlooked and wasted is assured by the following provision:

> The Council's policy provides for the integration of the results of all studies. In outlining its program of research, the Council will take into account other adequate studies in the field which have already been conducted, which may be contemplated and which may be under way; and it will assign each of its own studies, so far as is practicable, to other research agencies, such as universities, hospitals and professional organizations. Finally, it will constantly seek to integrate the results of all studies for the purpose of resolving contradictions, of filling gaps in existing knowledge, and of making available a reasonably complete and well-organized body of factual data in a form which will assure its usefulness.
>
> Whether the findings of the various studies are favorable or unfavorable to the use of alcoholic beverages, they will be published without prejudice.

Members of the Scientific Committee, in addition to Dr. Clarke, are:

> Philip Bard, professor of physiology, the Johns Hopkins University; Walter B. Cannon, professor of physiology, Harvard University; Alan M. Chesney, dean, School of Medicine, the Johns Hopkins University; Edwin G. Conklin, professor of biology, Princeton University; Thomas R. Crowder, director, Department of Sanitation and Surgery, Pullman Company; Frederick P. Gay, professor of bacteriology, Columbia University; Frank B. Jewett, president, Bell Telephone Laboratories; Norman Joliffe, Bellevue Hospital, New York; E. K. Marshall, Jr., professor of pharmacology, the Johns Hopkins University; George B. Pegram, professor of physics, Columbia University; Charles R. Stockard, professor of anatomy, Cornell University; Edward A. Strecker, professor of psychiatry, University of Pennsylvania; Warren T. Vaughan, physician, Richmond, Virginia; C. H. Watson, medical director, American Telephone and Telegraph Company; Willis R. Whitney, vice-president in charge of research, General Electric Company.

Additional members of the Council are:

> Anton J. Carlson, professor of physiology, University of Chicago; Ray Lyman Wilbur, president of Stanford University; J. McKeen Cattell, editor, The Science Press; Walter M. Dickie, director of public health, State of California; Charles H. Durfee, psychotherapist, Wakefield, Rhode Island; Vincent du Vigneaud, professor of biochemistry, Cornell University Medical College; Foster Kennedy, professor of neurology, Cornell University; Eugene Opie, professor of pathology, Cornell University; Harlow Shapley, professor of astronomy, Harvard University; Wilson G. Smillie, professor of public health, Cornell University; M. H. Soule, professor of bacteriology, University of Michigan; John Sundwall, president, American Association of School Physicians; H. E. Himwich, professor of physiology, Albany Medical College; Arthur H. Compton, professor of physics, University of Chicago; Otto P. Geier, chief medical officer, Cincinnati Milling Co.; Clarence M. Hincks, general director, National Committee for Mental Hygiene; Esmond R. Long, director, Henry Phipps Institute; R. A. Millikan, chairman, Executive Council, California Institute of Technology; Stuart Mudd, professor of bacteriology, University of Pennsylvania; Bernard Sachs, neurologist, New York; W. A. Sawyer, medical director, Eastman Kodak Company; Loyal A. Shoudy, chief medical officer, Bethlehem Steel Company; C. V. Weller, professor of pathology, University of Michigan; Reginald M. Atwater, executive secretary, American Public Health Association; George Howard Gehrmann, medical director, E. I. du Pont de Nemours Co.; McIver Woody, physician, Standard Oil Company of New Jersey; John L. Rice, commissioner of health, City of New York; Adolf Meyer, psychiatrist-in-chief, the Johns Hopkins Hospital; Howard Funk, principal, Junior High School, Bronxville, N. Y.; Fred J. Kelly, chief, Division of Higher Education, U. S. Office of Education; Daniel Prescott, professor of education, Rutgers University; Homer P. Rainey, director, American Youth Commission of the American Council on Edu-

cation; Thomas D. Wood, chairman, Joint Committee on Health Problems in Education, National Education Association and American Medical Association; Willard W. Beatty, director of education, U. S. Office of Indian Affairs, recently president, Progressive Education Association; Frank P. Graham, president, University of North Carolina; R. A. Kent, president, University of Louisville; Roy G. Ross, general secretary, International Council of Religious Education; Donald J. Cowling, president, Carleton College; F. L. Bishop, Highway Education Board; John Q. Rhodes, president, Association of Motor Vehicle Administrators; Roger William Riis, public relations counsel; W. Roy Breg, executive secretary, Allied Youth; Thomas H. MacDonald, chief, United States Bureau of Public Roads; Russel E. Singer, general manager, American Automobile Association; Samuel Thorne, attorney; Thomas D. Thacher, attorney; Percy Jackson, attorney; Harold B. Hoskins, vice-president, Cannon Mills, Inc.; Edward W. Freeman, vice-president, Suchar Process Company; Edwin C. Jameson, president, Hamilton Fire Insurance Co.; Graham Edgar, vice-president, Ethyl Gas Corporation.

SPECIAL ARTICLES

INFLUENCE OF ADRENALECTOMY ON ANTERIOR PITUITARY KETOGENESIS IN RATS

IN 1934 Long and Lukens[1] first described experiments revealing that adrenalectomy produces a marked reduction in the ketone body excretion of the depancreatized cat. Since then a number of investigators have reported that adrenalectomy similarly affects the ketonuria consequent to phlorhizin intoxication,[2] pregnancy,[3] fasting[3] and the administration of extracts of the anterior pituitary gland.[3,4] This reduction in ketonuria has been attributed to a decrease in ketone body formation consequent to the removal of the adrenal cortex. However, several other interpretations of the decrease in ketonuria are possible without having recourse to the hypothesis that the adrenal cortex, or its hormone, is essential for ketogenesis.

The observation made incidentally by MacKay and Barnes[3] that the adrenalectomized rat may develop a ketonemia after the administration of an extract of the anterior pituitary gland suggested to us that the adrenals may not be essential to the ketogenic activity of anterior pituitary extracts. For that reason, a series of studies was started to investigate more closely the blood and urinary ketone body content of normal and adrenalectomized animals treated with a crude extract of the anterior pituitary gland.

Rats were adrenalectomized forty-eight hours before the administration of a crude extract of beef anterior pituitary glands (A.P.E.), and were given normal saline "ad lib" during the interval. No attempt was made to maintain these animals for periods longer than forty-eight hours before administering A.P.E., since we did not desire the secondary effects of an adrenal insufficiency to interfere with effects attributable to the absence of the glands *per se*. All animals, normal and adrenalectomized, were fasted for seventeen hours before the injection of A.P.E. subcutaneously and of saline intraperitoneally. Following the injections, the urine was collected for eight hours and its ketone body content determined by the method of Van Slyke and Fitz. At the end of the eight-hour period, the animals were bled from the aorta and the blood ketone body content was determined by the same method.

Our data, summarized in Table I, indicate that in the absence of the adrenal glands, A.P.E. administration is relatively ineffective in producing a ketonuria; an observation which is in accord with that of others. However, the blood ketone body content indicates no apparent disturbance in the ability of adrenalectomized rats to manufacture these substances. In fact, if anything, the blood ketone content of the adrenalectomized rats is greater than that of the normal animals. That of the adrenalectomized rats is 5.7 mgm per cent. higher than that of the normal group, the ratio of the difference of the means to the standard error of this difference being 2.53.

TABLE I

Experimental group	No. of rats	Average weight gms.	Fasted hours	Blood ketones* 8 hours after A.P.E. mgm per cent.	Urine ketones* 8 hours after A.P.E. mgm per 100 gm
Normal	20	191	17	18.2	5.9
Adrenalectomized .	17	163	17	23.9	0.9

* Expressed as acetone.

One possible explanation of these data is that presented by MacKay and Barnes,[5] who postulated that adrenalectomy results in an increased ketolysis, which in turn is responsible for the decrease in ketonuria. However, the fact that the blood ketone content is at least as great in our adrenalectomized animals as it is in the normal group makes it obvious that irrespective of whether ketolysis is or is not increased, the same degree of ketonuria should occur in both instances. Since a decreased ketonuria occurs in adrenalectomized animals and since ketogenesis apparently is undisturbed, ketolysis can not be regarded as the factor responsible for the decreased ketonuria.

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[1] C. N. H. Long and F. D. W. Lukens, SCIENCE, 79: 569, 1934.

[2] G. Evans, *Am. Jour. Physiol.*, 114: 297, 1936.

[3] E. M. MacKay and R. H. Barnes, *Am. Jour. Physiol.*, 118: 184, 1937.

[4] E. G. Fry, *Endocrinology*, 21: 283, 1937.

[5] E. M. MacKay and R. H. Barnes, *Am. Jour. Physiol.*, 122: 101, 1938.

A more plausible explanation for the discrepancy between the ketone body excretion and the blood ketone level is that following the removal of the adrenal glands, the renal threshold for ketone bodies is markedly increased. Thus, even with identical blood ketone levels the adrenalectomized animal will excrete less ketone bodies than will the normal. This is in accord with the observations of many investigators who have demonstrated that adrenal insufficiency is characterized by marked abnormalities in renal function,[6] and hence it is not surprising that these renal disturbances manifest themselves by an inability of the kidney to maintain its normally low threshold for ketone bodies.

Our data suggest the conclusion that the adrenal gland *per se* is not essential for the ketogenic activity of extracts of the anterior pituitary gland and that an increase in the renal threshold for ketone bodies is responsible for the decreased ketonuria observed in the adrenalectomized animals treated with A.P.E. However, this does not exclude the possibility that in late stages of adrenal insufficiency secondary changes in liver function ensue, with a consequent decrease in ketogenesis. These and other studies will be published in greater detail elsewhere.

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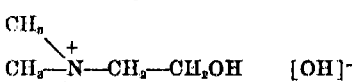
THE CHEMICAL NATURE AND NOMENCLATURE OF CHOLINE DERIVATIVES

Considerable confusion exists as regards the nomenclature and understanding of the chemical nature of compounds of the choline type. Choline is an organic homologue of ammonium hydroxide, but the name suggests an amine. Perhaps because of this inappropriate name it is not generally appreciated that choline, like tetramethylammonium hydroxide, is a very strong base, comparable with the caustic alkalies. Like sodium hydroxide, choline reacts with hydrochloric acid to form a chloride, a term which should be used in preference to "hydrochloride." Like sodium chloride, in aqueous solution the chloride salt of choline is neutral in reaction and dissociates into cations and anions. Strictly speaking, choline salts should no more be termed "choline" than should sodium chloride be referred to as "sodium," or ammonium chloride as "ammonium." The term "choline hydrochloride" is incompatible with the structure of this "onium" compound and the use of such terminology (by research workers and manufacturers) contributes to the erroneous idea that the chloride salt contains loosely bound hydrochloric acid which should be neutralized before biological use. It is obvious that these comments apply equally forcibly to the various derivatives of choline such as acetylcholine, "mecholyl," etc.



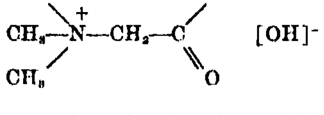
$$\mathrm{(CH_3)_3\overset{+}{N}{-}CH_2{-}CH_2OH\qquad[OH]^-}$$

Ordinary nitrogenous compounds containing tri-(co)valent nitrogen form "salts" with hydrochloric acid by the addition of the hydrogen ion through a covalent link (shared electron doublet), making the molecule a cation and enabling it to hold the chloride ion by electrovalency. Such "salts" are termed hydrochlorides, although the nomenclature appears to have no justification except that of common usage, for "salts" with other than simple halogen acids are not so designated, for example, codeine phosphate, strychnine nitrate, etc.

In compounds of the choline type the four-covalent-one-electro-valent state is constant, an anion being ever present, whether it be hydroxide, chloride or bicarbonate. Substances of this type are classified as onium compounds and the names of the salts are derived in the same manner as are those of sodium hydroxide; for example, choline chloride, trimethyl-β-hydroxyethylarsonium bromide, tetramethylphosphonium sulfate, etc.

The importance of the charged nitrogen atom is evidenced not only by derivatives of choline, but also by such biologically significant compounds as vitamin B_1 and the nicotinic acid amide portion of the coenzyme system.

The nomenclature of the biological oxidation products of choline is unfortunate. Betaine aldehyde, the primary product of oxidation, has a particularly undesirable name, since it implies that the compound possesses the properties of a betaine, which is not the case. In aqueous solution betaine aldehyde and its salts are electrolytes, dissociating into cations and anions.



$$\mathrm{(CH_3)_3\overset{+}{N}{-}CH_2{-}CHO\qquad[OH]^-}$$

The name "betaine" (pronounced *bē' tä in*) is generically applied to a large group of compounds having a zwitterion structure similar to that of the compound termed betaine specifically, the latter being the secondary oxidation product of choline.

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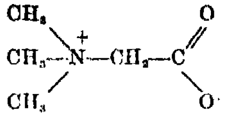
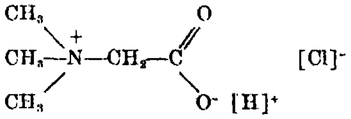
[6] A. Grollman, "The Adrenals," pp. 170 and 180. Williams and Wilkins Company, Baltimore, 1936.



In the case of betaine the hydrochloric acid salt is usually referred to as betaine hydrochloride, and with a great deal more justification than in the case of the chloride salt of choline or of the so-called hydrochlorides of alkaloids, etc. Inspection of the zwitterionic nature of the hydrochloric acid salt of betaine



indicates that the hydrochloric acid is loosely bound; in fact the hydrochloric acid may be titrated as free acid. Pure crystalline betaine hydrochloride may well be used as a stable source of standard hydrochloric acid; doubtless other stable, crystalline salts of betaine might be used as standards for other acids.

The present confusing nomenclature might be avoided by the use of the cumbersome, but adequately descriptive, chemical names, or by the introduction of a more logical system of common names, preferably based on the familiar term "choline" as the root. Since the names which have been proposed so far fail to indicate the onium structure of the compounds, Professor Austin M. Patterson has suggested (in a personal communication) the name *cholinium* for the choline cation; this would permit the use of the terms cholinium hydroxide, cholinium chloride, acetylcholinium bromide, etc., for the salts and derivatives. In such a system betaine aldehyde might become aldocholinium hydroxide, a name which indicates its properties, and betaine aldehyde chloride, aldo-cholinium chloride, a term which suggests its chemical and physiological relationships. The root name *cholonium* would appear theoretically more sound, but might be accepted less readily, since the relation to the term now in common usage is less easily recognized. A satisfactory name for betaine itself is not easily found, its carboxy group being difficult to indicate (carboxycholinium, according to the international system, would indicate the replacement of a hydrogen of the choline cation by a carboxyl group); betainium is the only root name which would appear applicable, and this is far from satisfactory.

The writer will welcome suggestions and comments on this or other systems of nomenclature for the choline compounds. Professor Patterson has suggested that if the workers in this field should arrive at definite proposals regarding terminology, these proposals might be presented to the American committee on biochemical and organic nomenclature of the International Union.

The author wishes to express his appreciation for the advice and suggestions of Professor Austin M. Patterson, Professor C. F. Cori, Professor H. T. Graham and Dr. T. H. Jukes.

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BIOLOGICAL DETERMINATION OF VITAMIN B$_1$ (THIAMIN) IN RHIZOBIUM TRIFOLII

While studying growth factor requirements of the nodule bacteria, it became desirable to determine the ability of the organisms to synthesize vitamin B$_1$. Since only minute amounts of cellular material were conveniently available, feeding experiments were impractical. The situation required a rapid biological assay, applicable to small quantities of ordinary culture media.

For this purpose, a quantitative method was developed, which is an application of Knight's[1,2] demonstration that, under suitable conditions, the growth of *Staphylococcus aureus* is proportional to the amount of vitamin B$_1$ present in the medium. The base medium employed for the estimation of vitamin B$_1$ is similar to that of Knight[1,2] and Fildes,[3] but with the substitution of casein hydrolysate for gelatine hydrolysate or known amino acids:

Acid hydrolyzed casein	20 ml (equivalent to 0.4 gm Merck's casein)
Dipotassium phosphate	0.5 gm
Glucose	0.3 gm
Cysteine, HCl	2.0 mgm
Nicotinic acid	0.02 mgm
pH–7.0	
Distilled water to 50 ml	

Five ml amounts of this medium are tubed, and sufficient distilled water added so that together with the addition of the test material, the final volume is 10 ml. The medium is autoclaved one hour at 15 pounds, vitamin B$_1$ additions being made under aseptic conditions after sterilization.

A trace of growth from a nutrient agar culture is suspended in 10 ml water (approximately 100,000 bacteria per ml), one drop of which is used for inoculation. No growth occurs in the base medium. However, as shown in Fig. 1, in the presence of as little as .00005 micrograms per ml of vitamin B$_1$, detectable growth results, the amount of growth increasing rapidly with higher concentrations of the vitamin to .001 micrograms per ml. Growth is determined after

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[1] B. C. J. G. Knight, *Brit. Jour. Expt. Path.*, 16: 315–326, 1935.

[2] B. C. J. G. Knight, *Biochem. Jour.*, 31: 731–737, 1937.

[3] P. Fildes, G. M. Richardson, B. C. J. G. Knight and C. P. Gladstone, *Brit. Jour. Expt. Path.*, 17: 481–484, 1936.

incubation for 36 hours at 37° C. by turbidity measurements using the Evelyn electrophotometer.

One gram of pork liver, found by animal assay to contain 36 micrograms of vitamin B_1 per gram, was extracted four times for periods of five minutes each with boiling N/10 hydrochloric acid. This extract was adjusted to pH 7.0 with sterile sodium hydroxide and made up to 100 ml. The actual amount of vitamin B_1 present in dilutions of pork liver extract was calculated by comparing the resultant stimulation with that of known quantities of vitamin B_1 (see Fig. 1). The ordinates represent per cent. increase in light absorption due to turbidity, upon addition of the amounts of stimulant indicated on the abscissae. Those points falling on the steep part of the curve were selected for calculations. By obtaining several points in this region, a convenient check for a given determination is provided. An average from four separate determinations, none of which varied over 3 per cent. from the mean, was 32 micrograms vitamin B_1 per gram. Similar confirmations of the accuracy of the method when applied to biological materials were obtained with standardized samples of pork kidney and ham.

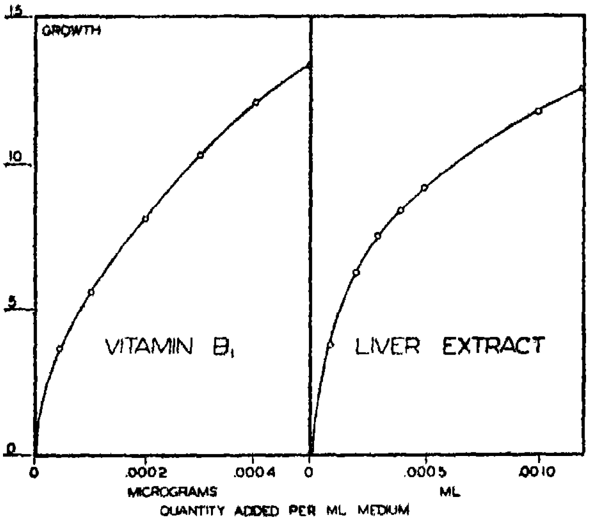

FIG. 1. Influence of vitamin B_1 on growth of *Staphylococcus aureus*. On left, the standard curve for pure vitamin B_1. On right, curve for liver extract to be assayed for vitamin B_1.

Six weeks' old cultures of *R. trifolii*, grown on a vitamin B_1-free synthetic medium were heated 15 minutes at 100° C. with N/10 HCl. This sufficed to liberate the free vitamin from combined form in which it apparently exists in the autolyzed cultures. Various cultures assayed averaged 19.6 micrograms of vitamin B_1 per gram of dry cells. This figure was in agreement with analyses by Meikeljohn's modification of Schopfer's test[4] which, however, is much less sensitive to vitamin B_1 and requires ten days for completion. From the data obtained, it appears that the vitamin B_1 content of *Rhizobium trifolii* cells closely approximates the amount known to be present in yeasts.

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SCIENTIFIC APPARATUS AND LABORATORY METHODS

APPARATUS TO ASSIST IN PHOTOGRAPHING EXPERIMENTAL MATERIAL[1]

The apparatus described herewith has proved to be a very convenient device for photographing laboratory specimens, especially small animals such as rats. The advantages of this apparatus lie in the fact that photographs are taken in the laboratory under uniform conditions of distance and light and at about one-tenth the usual cost when made by a commercial photographer, for the individual photographs, and less than one half the usual cost for the pictures finally selected and enlarged for printing. In addition to a saving of time, the animals are not exposed to abnormal conditions outside the laboratory.

The apparatus consists of a boxlike arrangement with [illegible] opening at one end for inserting a camera and a [illegible] door at the opposite end for inserting the speci- [illegible] be photographed. A lamp recess is located on each side of the box. The insides of the lamp recesses are painted with white enamel. The inside of the box in which the camera is placed is painted black. A removable glass partition, made of clear window glass 9″ by 18″, with a wing 4″ wide cemented 1″ from each end is used to retain rats within 4″ of the hinged back door. The hinged door carries a gray cardboard, which serves as a background. Gray is desirable as a background for most objects, but since the cardboard is attached with thumbtacks, other colors may be readily substituted as a suitable contrasting background for the particular specimen to be photographed. A yellow cardboard makes a desirable floor when rats are being photographed. A 15-centimeter rule for showing comparative sizes, and a white card with sufficient data to identify the specimen, the date and the number of the particular photograph are attached to the door. These become an integral part of the photograph, but, if placed on the upper part of the door, may be blotted

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[1] Published with the approval of the director of the New Mexico Agricultural Experiment Station.

[4] A. P. Meikeljohn, *Biochem. Jour.*, 31: 1441–1451, 1937.

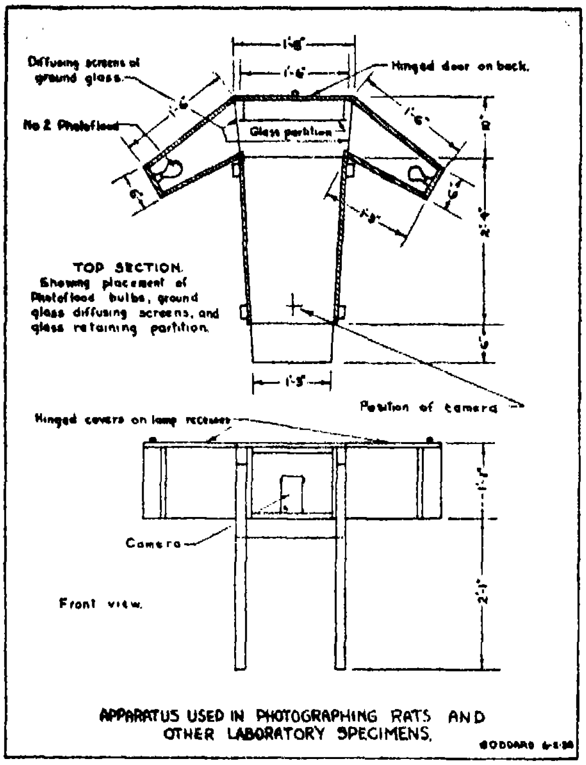
1'-8"
1'-6"
Diffusing screens of ground glass
Hinged door on back.
1'-6"
No 2 Photoflood
Glass partition
1'-6"
6"
6"
8"
1'-8"
2'-4"
TOP SECTION.
Showing placement of Photoflood bulbs, ground glass diffusing screens, and glass retaining partition.
6"
1'-5"
Position of camera
Hinged covers on lamp recesses
1'-1"
Camera
Front view.
2'-1"
APPARATUS USED IN PHOTOGRAPHING RATS AND OTHER LABORATORY SPECIMENS.
GODDARD 6-5-38

FIG. 1. Apparatus designed at the New Mexico Agricultural Experiment Station to assist in photographing rats and other laboratory specimens. The camera lens is placed 30 inches from the hinged door. The removable glass partition is 9″ × 18″ with four-inch wings cemented one inch from each end.

from the picture later if desired. A switch and plug-in light cord are attached to one side of the hinged back door. The dimensions given in Fig. 1 are for an apparatus to accommodate an Eastman kodak number 620, with a portrait attachment. Using supersensitive film, excellent photographs are secured with the lens of the kodak set 30 inches from the back wall, and with the kodak set for 1/25 second, an opening of 16, and the distance set as close as possible, slightly less than 5 feet. The objects photographed in this manner are approximately 14 per cent. of natural size, and when enlarged 3½ times, are ½ natural size. A photograph of a full-grown rat would thus be accommodated in the average journal page that is about 4⅝ inches wide. The dimensions given may readily be adapted to other cameras.

L. H. ADDINGTON

PHOTOELECTRIC "COLORIMETERS"

MESSRS. WARE AND PHIPPS, in SCIENCE, 88: 153, 1938, refer to certain alleged difficulties with the use of a single photocell in a photoelectric colorimeter, citing them as reasons for the development of another two-cell instrument. Inasmuch as such statements—though made, perhaps, because of insufficient information about a rapidly developing art—may create prejudice, it seems fair to present a correct statement regarding one of the instruments to which reference is made.

The authors state that the use of a single cell "requires a constant light source, the constancy of which is maintained by variable resistances in the lamp circuit, by a trickle charger on to a storage battery, or by a diaphragm placed between the lamp and the absorption cell." Of the three arrangements mentioned, the first makes possible the adjustment of current from a storage battery, whether or not the latter is kept on charge; but the light source is not thereby maintained constant except by manual setting. Obviously the purpose of the diaphragm can not be to maintain the light source at constant brightness.

The alleged difficulty of keeping the light source constant has been completely obviated in the Sheard-Sanford instrument through the use of a specially designed transformer which, on a source of constant frequency alternating current, maintains a constant power output regardless of voltage variations in the input. The purpose of the adjustable diaphragm is entirely different. It enables the operator to make precise adjustment of the amount of total light flux reaching the photocell, but does not affect the constancy of the light source. Neither are measurements with the Sheard-Sanford "Photelometer" affected by error "from the variations in the current produced by the cell caused by fatigue and changing temperature."

The Sheard-Sanford "Photelometer" is covered by U. S. Patents Nos. 2,051,317 and 2,051,320, the specifications in which disclose completely the principles employed in obtaining accurate measurements with a single photocell. All royalties from the sale of "Photelometers" have been assigned by Drs. Sheard and Sanford to the American Society of Clinical Pathologists.

P. E. KLOPSTEG

CENTRAL SCIENTIFIC COMPANY

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WORLD NATURAL RESOURCES[1]

By FRANK E. LATHE

NATIONAL RESEARCH COUNCIL, OTTAWA, CANADA

Introduction

It will, I think, be obvious that a subject as broad as that assigned to me to-night can not be fully treated in the time at my disposal. I therefore propose in the first place to review, very briefly, the fundamental resources that nature has placed at man's disposal; subsequently I shall discuss, at somewhat greater length, the adequacy or inadequacy of those resources to provide the requisites for food, clothing, shelter, heat and power.

It will not be sufficient, however, to consider the world's natural resources from the point of view of present methods of utilization alone. Resources in which we were not interested yesterday are of vital importance to-day; the useless or inert of to-day may to-morrow, through the contributions of science, profoundly affect the welfare of the human race.

To take only one example of how science and technology have made available a natural resource that probably would not even have been listed as such fifty years ago, let us consider the nitrogen of the atmosphere. Our knowledge of nitrogen as a plant and animal food goes back only about one hundred years. Research during the latter part of the nineteenth century demonstrated that the ultimate source of nitrogen was the air, from which it was derived through the action of micro-organisms in the soil, and atmospheric electricity. These, however, were natural agencies, over which man had little control, and in order to restore the depleted nitrogen of the soil he was dependent upon the application of animal wastes, nitrates obtained from certain natural deposits, and ammonia recovered as a by-product in the cooking of coal. Although such supplies were of a substantial character, they were recognized as insufficient for the ever-increasing population of the world, and the problem of obtaining an adequate source of nitrogen was the cause of much concern.

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[1] Paper presented June 27, 1938, before the American Association for the Advancement of Science, in the series on Science and Society.

Then came, in the first fifteen years of the present century, the development of the electric arc, the calcium cyanamide and the ammonia processes of nitrogen fixation, as a result of which nitrogen in cheap and convenient form became available in any quantity desired. This removed, for all time to come, the possibility of a world shortage.

This is but one illustration of the rôle of science in finding a complete solution to one of the major problems of food supply. Since at no period in the world's history has science been so active as it is to-day, I believe we may rest assured that where the fundamental resources exist in nature, man will eventually find the means for their utilization.

Fundamental Resources

In the ultimate analysis, we are dependent upon the abundance and availability of the different chemical elements in the world's crust, the ocean and the atmosphere. It will therefore be of interest to examine the magnitude of our natural resources as they exist in these major reserves.

TABLE 1

Estimated Composition of the Earth's Crust

Metals				Non-metals	
	Per cent.		Per cent.		Per cent.
Aluminum	7.96	Nickel	0.023	Oxygen	47.77
Iron	4.44	Strontium	0.02	Silicon	27.25
Calcium	3.51	Chromium	0.01	Hydrogen	0.22
Potassium	2.48	Copper	0.0075	Carbon	0.19
Sodium	2.47	Zinc	0.0040	Phosphorus	0.10
Magnesium	2.28	Lead	0.0020	Sulfur	0.10
Titanium	0.47	Silver	0.00001	Fluorine	0.10
Manganese	0.09	Gold	0.0000005	Chlorine	0.01
Barium	0.08	Others	0.20	Others	0.21
			24.05		75.95

Table 1 lists separately the principal metals and non-metals in the order of their abundance in the crust of the earth. It will be observed that the most common metal is not, as one might suppose, iron, but aluminum, which constitutes approximately one thirteenth of the earth's crust, as against one twenty-second for iron. These metals, as well as calcium, potassium, sodium and magnesium, exist in such enormous quantities that we need never fear that a shortage will develop. It is interesting to observe that the so-called "common" or "base" metals, copper, zinc and lead, are present to the extent of less than 0.01 per cent. each. Fortunately, nature has so concentrated them, and man has so thoroughly worked out their metallurgy, that they are cheaply available to the present generation. Their future, however, is somewhat obscure, for the known commercial deposits of these metals will nearly all be exhausted in the next 100 years, and most of them in less than half that time. No doubt other deposits will be discovered, particularly as the world's geology becomes more thoroughly worked out and scientific methods of prospecting for ore deposits are further developed. It may be expected, however, that sooner or later recourse will be had to deposits of lower grade, not now considered as ore, also to the increasing use of scrap metal and to the partial substitution of the commoner metals for those that are approaching exhaustion. In this connection, the enormous increase in the output of metallic aluminum during the past three or four decades is significant, as is also the still more recent commercial production of magnesium at relatively low cost.

Looking at the list of non-metals, some may be surprised to observe that oxygen and silicon together make up no less than 75 per cent. by weight of the earth's crust, in which, however, both of these elements exist only in combination. All the other non-metals listed also exist in quantity sufficient for both present and future needs. Even chlorine, given as 0.01 per cent., constitutes 60 per cent. by weight of common salt, of which there is no scarcity. Before we leave this subject, it should be noted that potassium and phosphorus, the bases of essential plant foods, are to be classed with the abundant elements.

Table 2 gives the quantities of the principal elements in solution in sea water, expressed as tons per cubic mile. Since sea water is at the door of virtually every country in the world, none of them need fear a shortage of these elements.

Last summer in California I visited the first commercial plant to recover magnesia from sea water; several others are now under construction or contemplated. Bromine, though relatively scarce, is recovered to the extent of about 15,000 tons per year in two commercial plants—approximately the quantity contained in one twentieth of a cubic mile of sea water. Even iodine, though present to the extent of only one part in 23,000,000 of sea water, amounts to 200 tons per cubic mile, and since the ocean is estimated to contain 300,000,000 cubic miles, the total quantity available in this natural reserve is no less than 60,000,000,000 tons.

The third main reserve of the elements is the atmosphere, the composition of which is shown in Table 3. Quantities are given in tons per square mile, and since there are about 200,000,000 square miles of the earth's surface, it is obvious that a nitrogen famine is not imminent! It is reassuring to find so much carbon dioxide, upon which all plant life depends; this is of course being returned to the atmosphere, through the oxidation of carbon, at substantially the rate of ab-

TABLE 2

ELEMENTAL RESERVES IN THE OCEAN

	Tons per cubic mile
Chlorine	90,000,000
Sodium	53,000,000
Magnesium	5,700,000
Sulfur	4,300,000
Potassium	3,300,000
Calcium	2,400,000
Bromine	310,000
Iodine	200

sorption by vegetation. The ocean, which dissolves carbon dioxide, and the atmosphere, in which it exists as a gas, together constitute a giant balance wheel, which takes up any variations in the natural cycle of plant growth and decay. The rare gases in the atmosphere are of more than passing interest, since these are already finding some practical applications, as, for example, in neon signs.

TABLE 3

GASEOUS RESERVES IN THE ATMOSPHERE

	Percentage by weight	Tons per square mile at sea level
Nitrogen	75.474	22,269,000
Oxygen	23.200	6,845,400
Argon	1.283	378,600
Carbon dioxide	.040	11,800
Neon	.00125	370
Hydrogen	.00070	207
Krypton	.00029	86
Helium	.00007	20
Xenon	.00004	12

FOOD

Just 140 years ago Malthus published his first essay dealing with what he believed to be a tendency for the world's population to increase faster than the means of subsistence. His ideas were widely accepted, and in the years that followed there were many who envisaged a time, in the not very distant future, when the world's population would increase to such an extent that an acute shortage of food would develop.

Let us look for a moment at the situation in the time of Malthus. Plant food was known to exist in the soil, but this quickly became depleted by continuous cropping. What could be more logical than to conclude that when all the cultivable land had been occupied the peak of food production would have been reached, and as further crops were removed the productivity of the soil would decrease?

One can scarcely blame Malthus and his followers for not being able to predict the solution of the immediate problem through the contribution which science would make to society. Since Malthus's time, potash has become available from the Stassfurt and other great deposits of potassium salts; soluble phosphates have been manufactured by treating natural rock with sulfuric acid or by appropriate furnace methods; nitrogen has been obtained from the various sources already mentioned. As a result, conditions have been completely changed in spite of the rapidly increasing world population.

As yet, only a beginning has been made in increasing food production. Every one familiar with scientific agriculture knows that a major increase in crop growth could be brought about, on the present acreage, by the more liberal application of potash, phosphoric acid and nitrogen and by the neutralization of natural acids. The elements iron, calcium, sodium, magnesium, manganese, zinc, copper, cobalt, sulfur, chlorine, iodine and boron are now all recognized as plant foods, or animal foods derived from plants, yet very little has been done towards determining the requirements of soils with respect to these elements and making the necessary additions. There can be little doubt that human and animal food supplies could be doubled or tripled if all necessary plant foods were applied in abundance.

Malthus believed, and it has often been stated even in recent years, that the soil is the world's most valuable natural resource. Actually, in view of the ease with which ordinary soil is depleted, we should regard it rather as a convenient medium through which nutrient can be made available to plants. As such it is of inestimable value, but Gericke has recently demonstrated in California that soil is not essential, for he has developed the new art of "hydroponics," or the growing of crops in nutrient solution without soil. It is of interest to note that tiny Wake Island in the Pacific, only half an acre in extent, is the newest hydroponic farm, and that crops will be grown there for the passengers and crews of transpacific Clipper planes. May this not be a picture of the intensive farming of the future, if the world's population should increase to the point where the cultivable areas of the earth's surface are too limited in extent?

The progress of the plant breeder has been another major factor in deferring the time of distress predicted by Malthus. The development of early-ripening varieties of wheat, for example, has pushed well to the north the zone in which this most important cereal can be grown, a zone, be it noted, extending around the world where land areas are greatest. An equal triumph has been scored in the breeding of rust-resistant varieties of wheat, now for the first time available in large quantity. In 1935 the loss from rust in western Canada alone was officially estimated at fully 100,000,000 bushels of wheat, and on the average the loss would amount to at least 25 or 30 millions annually. Within five years the losses from wheat rust should be substantially eliminated from all countries of the world.

Recently research has been organized on the destruction of weeds, the losses from which in the United

States have been estimated to amount to more than those from insects and all plant and animal diseases combined. Improved cultural practices have already been evolved, chemicals have been found that will destroy undesirable vegetation, and even some that will selectively kill certain annual weeds and leave cereal crops substantially undamaged.

The advances in plant and animal pathology have been scarcely less remarkable than those in breeding. One need only mention a few—the chemical disinfection of seed grain and potatoes, the control of hog cholera, the reduction of tuberculosis in cattle—to realize the importance of these developments. Further, there is a growing recognition of the fact that a number of plant and animal diseases are not caused by any specific organism, but are the result of deficiencies in food supply. For example, the application of a small amount of boron to soil prevents drought spot and corky core of apples and alfalfa yellows; the administration of a minute trace of cobalt prevents a serious deficiency disease of sheep.

I would remind you, too, that our food supplies are not derived entirely from land areas, but also from water areas, which constitute some 75 per cent. of the total surface of the earth. The world production of fish now amounts to nearly 15,000,000 tons per year, or about 15 pounds per person. Japan alone has over 1,000,000 persons employed in fishing.

The subject of food resources would be incomplete without mention of what, if it eventuates, may prove to be an accomplishment of the most far-reaching importance. Chemists have already synthesized thousands upon thousands of complex compounds; if they are successful in commercially synthesizing carbohydrates for human and animal food, they will have achieved their greatest triumph, and that is a feat the possibility of which can not be lightly dismissed.

CLOTHING

Probably the earliest type of clothing worn by mankind consisted of the skins of animals, and one can almost picture the Malthusians of that day predicting the time when the world's population should have increased to such an extent that insufficient furs and skins could be obtained. As a matter of fact, that period would have arrived relatively soon, but for the existence of plant and animal fibers and the development of the art of weaving. By that technological advance a clothing shortage was indefinitely postponed.

But what of the future? If the world's population is doubled or tripled, will there be sufficient raw materials to provide clothing for all? Let us consider our present resources.

Cotton is by far the most important textile fiber, its annual production being about three times as much as that of all others combined. Without examining in detail the production of the major cotton-growing countries we may note that the United States grows just about half of the world's production, and this on 30 or 40 million acres, or say 2 per cent. of the total land area of that country. If the demand were to arise, cotton could be produced sufficient for three or four times as great a world population as that of the present, without making any serious inroads on the areas required for food production.

A similar situation exists in regard to wool. The single island of Australia now produces 25 per cent. of the world's wool, and could produce on an even larger scale. Great Britain and New Zealand both have an average of more than 200 sheep per square mile; Canada has only one! I would not wish to imply that all countries could equal the record of these two, but in Canada, for example, at least a tenfold increase in sheep population would seem quite feasible.

But we are no longer dependent upon natural fibers, for in the last 25 years the problem of the commercial production of synthetic fibers has been solved, and a great new industry has sprung up. In 1920, for the first time, the production of rayon in the United States exceeded 10,000,000 pounds; in 1937, it was more than 300,000,000. The world production in 1936 was 1,303,165,000 pounds, yet this is one of the newest industries. Thus, through developments in science and technology, an entirely new resource for the manufacture of textiles has been provided, one sufficient to clothe untold millions of people.

But rayon is not to be permitted to monopolize the field of synthetic fibers. For several years a so-called "artificial wool" has been made in Italy from casein, a product of skim milk. Now reports come from Japan that a similar fiber has been made there from soybean protein. While the present product appears to be definitely inferior to natural wool, it must be remembered that the first rayon was so weak as to give rise to the prediction that no large market for it would ever be developed.

SHELTER

The problem of shelter has been a live one since the earliest days of the human race. Primitive man took refuge in caves to protect himself from the cold, the rain and the attacks of wild beasts, but the number of suitable caves was very limited, and history bears mute record that competition for them was keen. Doubtless man, with his rude weapons, frequently came off second best in the conflict which took place for their possession.

With the development of the simplest wood-working tools forests became the major source of raw material for the provision of shelter. For thousands of years this invaluable resource has been used as lavishly as if it were inexhaustible, and indeed this is even to-day the situation in many countries. In Canada, for example, the forests are being destroyed—by man, insects and fires—some two-and-a-half times as fast as they are grown. The United States, although possessing not more than 10 per cent. of the total forest stand, is responsible for approximately 40 per cent. of the world's cut.

Nevertheless, the situation is not by any means hopeless. There are still vast forest areas, estimated to be as much as the area of the whole of North America plus Australia. The approximate distribution of this area is shown in Table 4, from which it will be evident that about two thirds of the total is in the possession of four of the world's political units, the U.S.S.R., the British Empire, Brazil and the United States. The Scandinavian countries and some others with relatively small area have had the foresight to institute scientific forest management, under which the forests are placed on a permanent basis and made to yield an annual crop.

TABLE 4

WORLD'S FOREST RESOURCES

	Percentage of the world's forest area
U. S. S. R.	21.1
British Empire (40 per cent. Canadian)	21.0
Brazil	13.4
United States	9.1
France and dependencies	3.9
Argentina	3.5
Japan	1.2
Germany and Austria	0.5
Italy and Abyssinia	0.4

The world's annual growth of wood is about 38,000,000,000 cubic feet. If all forests of the world were properly protected and given reasonable care, it is estimated that they could produce annually 350,000,000,000 cubic feet. It is thus evident that an appreciation of the seriousness of the situation, coupled with the general application of scientific methods of forest protection and growth, would provide for the needs of a population much greater than that of to-day.

Man discovered at an early date that excellent shelter could be secured by using mineral raw materials. Rock could be built up into substantial walls; clay dried in the sun became hard, and in desert countries afforded sufficient protection against the elements. Burnt clay blocks, or brick, became cheaply available. Clay being one of the most abundant of all mineral reserves, the potential brick supply is unlimited.

Concrete has become one of the major building materials. Gypsum products are now being applied in a wide field. Further, new materials, such as glass blocks, stainless steel and enamelled iron, are being introduced, providing variety in appearance and a wide range of physical properties. Nor has nature apparently fixed any limit to the quantities of such materials that may be used for the provision of shelter.

HEAT AND POWER

The major present sources of heat and power are coal, oil, natural gas, wood, peat and the energy of falling water. The use of wood and water power date back to prehistoric times. Coal was possibly used in China 2,000 years ago, but its use in the western world did not begin on any considerable scale until the latter part of the thirteenth century. As late as 1306, Edward I of England compelled all except smiths to cease burning coal and revert to the use of wood.

Table 5 shows the coal reserves of the world, as compiled by the International Geological Congress of 1913. It should be explained that, in the compilation of those reserves, all countries were asked to include seams of economic value one foot or more in thickness and not more than 4,000 feet from the surface, and in addition coal in seams two feet or more in thickness and at depths between 4,000 and 6,000 feet. No allowance was made for mining losses, which are very heavy. The figures therefore should be taken as a very generous estimate of the minable coal of the world.

TABLE 5

COAL RESERVES OF THE WORLD

	Millions of metric tons
United States	3,838,657
British Empire	1,729,105
China	995,587
Germany and Austria (1913)	477,232
U.S.S.R.	173,879
France and dependencies	37,585
Japan	7,970
Italy	243
World total	7,397,553

The most striking thing about these figures is the uneven distribution of coal reserves throughout the world. More than half of the total is in the United States, and 73 per cent. is in North America. Canada's proportion is about 17.5 per cent., or three quarters of that of the British Empire. Nevertheless, the reserves in China, Germany, U.S.S.R. and France are so large that no concern need be felt for a long time to come regarding the exhaustion of those deposits. Considering the world as a single unit, it may be observed that the tonnage of coal is so large that at the maximum rate at which it has yet been mined it would last for about 5,000 years. Even if the minable coal be half that quantity and the rate of mining should substantially increase, it is obvious that the supply is adequate for many hundreds of years. If, on the other hand, we take a backward look, a period of 2,000 years carries us only to about the beginning of the Christian era, and the world's coal reserves must be regarded as possibly exhaustible within a similar period.

The present production of oil and gas is derived chiefly from the United States, which is responsible for some 60 per cent. of the world's total, and uses a correspondingly large proportion.

I shall not attempt to show the world's reserves of petroleum or natural gas, because these are so difficult to estimate. Twenty-five years ago it was predicted by some authorities that the reserves of petroleum would be substantially exhausted by the present time. Yet, in spite of an enormous increase in consumption, the supply seems greater than ever. Vast areas remain virtually unexplored as sources of oil and gas. Nevertheless, the known reserves are being depleted at such a rate that one can not with much confidence predict a natural supply sufficient for more than 50 or 100 years.

Even though the present deposits of crude oil be exhausted, however, there need be no shortage of liquid fuel. In many parts of the world there are large deposits of oil shales, which, though not ordinarily minable at a profit under present conditions, constitute a large potential reserve of oil. In Alberta, there is an enormous deposit of tar sands, extending over thousands of square miles, and it is estimated to contain sufficient bitumen to supply the world with oil for centuries. Further, motor fuel can be readily produced by the hydrogenation of coal and cellulose, and both methyl and ethyl alcohol can be used in internal combustion engines. One need therefore feel no anxiety for a long time to come about the world's liquid fuel supplies.

Wood and peat are still available in large quantities as fuel. The former has already been discussed, but it may be pointed out that its use as fuel is decreasing in most countries, although over large areas it will long continue to be an important local fuel. Peat deposits are all of a shallow character, and, although of considerable importance as a domestic fuel reserve, peat is not likely to be used on a very large scale.

It is almost equally difficult to obtain reliable figures regarding the water power available throughout the world. One authority gives the total water power of the U.S.S.R. as 3,000,000 horsepower; another makes an estimate of 165,000,000 for Asiatic Russia alone. The total for the British Empire is about 68,000,000 horsepower, of which approximately half is in Canada. That of the United States is about 55,000,000, of Norway and Sweden 22,000,000. Many of the great waterfalls of the world are remote from industrial areas, as, for example, Victoria Falls in Central Africa, the available horsepower of which has been estimated at 35,000,000, or five times that of Niagara. The total available water power of the world at an average six-months' flow is probably not less than 400,000,000 horsepower and may be substantially more.

Water power has a great advantage over most of the resources so far discussed in that it is, ordinarily speaking, of a permanent character and therefore inexhaustible. Nevertheless, the utility of any waterfall depends largely upon the amount of its minimum flow, which, for maintenance at a high level, requires regulation. Regulation is accomplished to a large extent in nature through the existence of forest areas and limited drainage; man has a tendency to cut the forests and drain the land, thereby accentuating both the maximum and minimum flow. Care must therefore be taken to see that even this valuable resource is not destroyed.

Two sources of power that have not yet been drawn upon heavily are winds and tides. The total amount of wind power is enormous, and its distribution is world-wide. On the other hand, its utilization is relatively costly and the supply is intermittent. Winds may become an important source of power as coal and oil reserves approach exhaustion, particularly if the cost of the storage of power to provide for periods of calm weather can be reduced. The tides are also a potential source of much power, but conditions on most coasts are not favorable to their utilization.

All these resources of heat and power have been, or are being, derived indirectly from the radiant energy of the sun. To use the sun's energy directly has long been the dream of inventors the world over, and a number of them have been technically though not commercially successful. A new attempt is now to be made, this time on a more comprehensive scale, at the Massachusetts Institute of Technology. Physical and chemical methods are to be tried, and also a biological method through the speeding up of the growth of trees.

The total quantity of heat derived from the sun's rays is enormous. President Compton, of the Massachusetts Institute of Technology, illustrates this by pointing out that in the temperate zones, during the three months of greatest sunshine, each acre of land receives the heat equivalent of about 250 tons of good coal. From this it is evident that the proportion of the sun's heat normally utilized in the growing of vegetation must be extremely small.

The heat of the earth's interior has often been mentioned as a potential source of power, and steam escaping from the ground near active volcanoes is already being used on a small scale. In most parts of the earth's surface, however, the temperature increase with depth is so slow as to offer little encouragement for the utilization of the heat of the interior.

Reference has often been made in the literature to the enormous stores of energy locked up in atoms, and attention has been called to the automatic decomposition of radium to form elements of lower atomic weight. Undoubtedly there exists within the atoms an exceedingly high concentration of potential energy, but doubt may be expressed as to the likelihood of its utilization. I believe it was the late Dr. Slosson who referred to this source of heat and suggested that if man were ever successful in developing it he would find it difficult to control. The success of his experiment, Slosson thought, would be announced to the universe at large by the appearance, in the place now occupied by the earth, of a new star.

MISCELLANEOUS MATERIALS

A vast assortment of raw materials is drawn upon to meet the requirements of industry, whose purpose it is to provide man with the necessities of life, to satisfy his craving for pleasure, and, be it said to his discredit, to give him those facilities used for the destruction of his fellows. I have already dealt with most of the necessary raw materials, and reference need be made here to only three—iron, rubber and paper.

It has been pointed out that of the metals iron is second in abundance only to aluminum. The ultimate availability of this metal is therefore sufficient permanently to provide for the needs of mankind. In view of the dominant position of iron amongst the metals it is worth considering the magnitude and distribution of the world's reserves.

The maximum world production of pig iron in any one year may be taken as 100,000,000 long tons, which was the figure for 1937. It is estimated that the positive iron ore reserves of North and South America could supply the world's requirements at this rate for 40 years, and the probable reserves are sufficient for an additional period of 320 years. For Europe the corresponding figures are 50 and 160 years.

Other countries also have large reserves, but none comparable with those given. The total positive and probable resources of the world are sufficient at the present rate of consumption for about 600 years. This is a highly satisfactory situation, especially in view of the fact that enormous tonnages of lower-grade material are known to exist, and the probability that other large deposits will be discovered.

Rubber grows wild in a number of tropical countries, but the major production is now derived from plantations, where rubber trees are grown in a systematic way. The peak of rubber production was reached in 1929, with 863,410 tons. This would require 10,000 square miles of rubber trees, an area small enough to indicate that production could be multiplied many times, if the demand should arise. Many countries, however, lack the climatic conditions necessary for growing rubber trees, and in order to reach national self-sufficiency have sought substitutes. In the past few years success has been attained in such efforts through the production of various types of synthetic rubber. In some respects synthetic rubber is superior to natural rubber, for example, in being very resistant to the action of petroleum products. In Russia its manufacture has already become a national industry.

The enormous increase in the use of paper in recent years has been a major factor in the rapid cutting of the world's forests. Up to the present, conifers have been by far the largest source of wood for the manufacture of paper. Recently, however, more attention has been paid to hard woods, and methods have now been developed in the United States for the utilization of southern pine. Straw and other natural fibers are available in vast quantities and can be used if required; it is largely a question of economics.

In the light of what has already been said about the world's forests, it may be concluded that at the present rate of paper consumption the supply of raw materials can be maintained indefinitely. If the upward trend of consumption should continue, price increases sufficient to curtail present wasteful practices in the use of paper may be expected.

COMMENTS AND CONCLUSIONS

Thanks largely to science and technology, food supplies are likely to be adequate for a world population at least three or four times that of to-day, provided, of course, that the problem of distribution, with which this paper does not attempt to deal, can be solved. Although the future of some of the base metals is obscure, the world as a whole need fear no shortage for an indefinite period of the raw materials for clothing, shelter, heat, power and the principal necessities and luxuries of life. In the case of certain natural resources that are definitely exhaustible, nature has made abundant provision of possible substitutes.

All this is true of the world as a single economic unit. Unfortunately, however, the world is made up of a large number of economic units, many of which are endeavoring to establish economic self-sufficiency. For them the prospect is very different. Complete economic self-sufficiency is impossible, and even the measure of self-sufficiency for which many of the great powers of to-day are striving can be attained only by a major sacrifice of the standards of living.

In order to illustrate the extreme mutual dependence of the nations I have brought together in Table 6 some of the facts disclosed in our study to-night, and certain others which there has been no time to discuss. In this table the number "1" is taken to represent sub-

TABLE 6

NATIONAL SELF-SUFFICIENCY IN MAJOR MINERALS

	Br. Emp.	U.S.A.	U.S. S.R.	France and Dep.	Germany	Italy	Japan
Coal	1*	1	1	1	1	2	2
Iron	1	1	1	1	2	3	3
Copper ...	1	1	2	3	3	3	2
Lead	1	1	3	3	1	2	3
Zinc	1	1	2	2	2	3	2
Nickel	1	3	3	2	3	3	3
Tin	2	3	3	3	3	3	3
Asbestos .	1	3	1	3	3	3	3
Petroleum	3	1	1	3	3	3	3

* Numerical order represents decreasing abundance in relation to national requirements.

stantially complete self-sufficiency, "2" partial or temporary self-sufficiency, and "3" definite lack of self-sufficiency.

From this it is evident that not a single one of the seven great powers is completely self-sufficient in supplies of the major minerals. The British Empire and the United States are, without question, in the happiest position in this respect. The U.S.S.R. is, I think, in a better relative position than that indicated by the table, since so large a part of her vast area is virtually unprospected. The other nations are very dependent upon international trade in minerals.

Nature has been generous in providing for man an abundant supply of the things he most needs, and will continue to provide for him, even though his wants be still further increased. Individual nations, on the other hand, are laboring under serious handicaps, largely self-imposed, and are suffering severely as a consequence. Let us hope they may eventually realize that the highest standards of living for their people can be attained only through international cooperation and world peace.

OBITUARY

EARL BALDWIN McKINLEY

THE disappearance of the Hawaii Clipper at sea on July 29 with its crew and passengers was a vital loss to medical education and medical research, for a passenger on this ship was a man who at the age of forty-three had risen to prominence and leadership in these fields. It was a great loss as well to various scientific societies in whose development this man had played a significant role. Every organization with which this leader came in contact felt the impact of his personality and was carried to higher levels of accomplishment. He was a man of the highest ideals, absolutely fearless in adhering to them. Original and ingenious in his ideas, he excelled in all these activities as well as in his research, to which he was devoted. Inspired by Novy and Vaughan while a medical student at the University of Michigan, his activity in research never faltered throughout all the administrative and organization work which engaged his attention. With apparently many years ahead of him for further outstanding accomplishments, it was a tragedy to have him disappear from our midst at such an early age; yet there is the satisfaction that Earl Baldwin McKinley was lost in the line of duty, seeking new knowledge, pioneering as was his wont.

Dr. McKinley was a passenger on the Clipper with Fred Campbell Meier, of the Department of Agriculture, for the purpose of making studies in aerobiology. These workers had become interested in the question of the transmission of various bacteria and pollens through the upper atmosphere over the high seas. McKinley also intended to continue his leprosy studies at Manila while awaiting the return of the Hawaii Clipper from its hop to China, and had made detailed arrangements for the skin testing of 500 lepers.

McKinley was born in Emporia, Kansas, on September 28, 1894, the son of Joseph Baldwin McKinley and Mary Elizabeth (Griffith). He left Emporia to enter the University of Michigan in 1912 and received his A.B. degree at that institution. His formal education was interrupted by the world war and soon after graduation he entered the service. Before leaving for overseas he married on June 23, 1917, Leola Edna Royce, a classmate of his at the University of Michigan. He served in the front-line trenches as an intelligence officer, and at the close of the war returned to this country, serving for a short time in the Medical Corps. In 1919 he re-entered the University of Michigan for his medical studies and became an assistant of Professor Novy. He accepted in 1922 the post of assistant professor in pathology and bacteriology in the College of Medicine of Baylor University. The next year he was made professor of hygiene and bacteriology and chairman of the department.

While at Baylor he continued his researches but, desiring further training, he resigned his professorship to become a fellow of the National Research Council and spent a year working under Jules Bordet at the Pasteur Institute of the University of Brussels. Upon his return to this country he accepted an assistant professorship of bacteriology at the College of Physicians and Surgeons, Columbia University. The following year he was made an associate professor, which post he held for only one year, resigning to become affiliated with the Rockefeller Foundation. During [illegible] 1927–28 he served as field director of the [illegible] Health Board at Manila in the Philippi[illegible] member of the Advisory Committee t[illegible] General for the Control of Leprosy. [illegible] of this work he again became a [illegible] of Columbia University, being appointed professor of bacteriology of the College of Physicians and Surgeons and director of the School of Tropical Medicine at the University of Puerto Rico. In 1931 he was invited to the deanship of the School of Medicine, The George Washington University, a post which he held at the time of the flight of the Clipper. He also held the post of professor of bacteriology and executive officer of the department of bacteriology, hygiene and preventive medicine.

Both the School of Tropical Medicine and The George Washington University profited by his vision and organizing ability. During his régime the School of Tropical Medicine prospered both materially and scientifically. What he accomplished at the School of Medicine of The George Washington University was truly amazing. He brought the school into national prominence. With his driving enthusiasm and love of research he inspired all those about him to greater accomplishments. Throughout his deanship of seven years, he held uncompromisingly to his high ideals of medicine. What he did for the school can be no better stated than by what Dr. H. H. Donnally, professor of pediatrics in the Medical School, wrote of him soon after his disappearance:

> His place can not be readily filled for a long time. The next few years will prove how much George Washington will miss the leaven of science worked up by Dr. McKinley. . . .
>
> He was an inspiring leader and did many things to advance the school, to enrich its student life and to stimulate accomplishment by men composing the faculty. He was enthusiastic and sympathetic for our scientific aspirations and ambitions.
>
> He lived the adventurous life, explicitly so, and lost his life a martyr to scientific endeavor.

Perhaps the most amazing aspect of the career of McKinley was the research he was able to accomplish under the exacting administrative load that he carried for the greater part of his professional life. Communications on a variety of subjects appeared throughout his fifteen years of scientific endeavor. Such subjects as bacteriophage, toxic and insulin-like substances in fruit, effect of fresh adrenal cortex on the white rat, toxicity of globulins, effect of ultra-violet light upon phage and viruses, microbial respiration, cerebral circulation, herpetic encephalitis, *Leptospira icterohaemorrhagiae* in wild rats of the Philippines, experimental measles in monkeys, salivary gland poison of *Aëdes aegypti*, acute filarial lymphangitis, cultivation of *Mycobacterium leprae*, epidemic encephalitis, effects of tropical climate under experimental conditions, etiology of leprosy, geography of disease and sulfanilamide in virus diseases, are some of the subjects which engaged his attention and attested to his wide interests and to his versatility. His strongest interests, however, fell definitely along certain lines. These are unquestionably the phage, encephalitis, leprosy and the geography of disease. These subjects attracted his greatest efforts, and in each of these fields he made noteworthy contributions. There is reason to believe that time and history may record some of his contributions as landmarks.

Of perhaps equal value to McKinley's actual experimental contributions were his contributions to the field through his efforts on the behalf of and in the organization of various societies and committees. He was a man who could accomplish things. His time and energy were repeatedly called upon. He gave unstintingly of these and devoted himself unselfishly to the furtherance of these organizations. Men learned to lean upon him.

The society to which he devoted perhaps the greatest amount of time was the American Association for the Advancement of Science. He was in full sympathy with the purposes of this society and what it was doing, and threw himself wholeheartedly into the solution of problems facing the association, as a member of the executive council. He devoted likewise much time and effort to the problems of the American Leprosy Foundation and was secretary and member of the Medical Advisory Board for a number of years.

At the time of his trip on the Clipper, McKinley was president of the American Association of Pathologists and Bacteriologists, and was on the Executive Committee, Division of Medical Sciences of the National Research Council. He served on the editorial boards of the Society of American Bacteriologists and of the American Association of Immunologists. He was also a member of numerous other medical and scientific societies here and abroad.

McKinley possessed a great capacity for friendship and created innumerable friends, not only in the national capital and through the nation, but also in many countries throughout the world. From the many letters written to his family following the disappearance of the Clipper it was evident how dearly he was held in the hearts of his friends, how deeply they appreciated his kindliness and generosity, how they had counted on his advice and counsel and how they treasured his friendship.

Lastly, a tribute should be accorded the loyal companion whom he had by his side throughout all his endeavors, for Mrs. McKinley has ever graciously and sympathetically assisted him. He also had the pleasure of having two charming and talented guests in his home for 17 years and 19 years, respectively, his son, Royce Baldwin, and his daughter, Elsbeth Janet, to whom he has left a fine heritage "to carry on."

VINCENT DU VIGNEAUD

CORNELL UNIVERSITY
MEDICAL COLLEGE

FREDERICK TILNEY

WITH the death of Dr. Frederick Tilney, on August 7, the American Museum lost a faithful friend and its staff an esteemed colleague. Dr. Tilney was appointed in 1932 to the honorary post of research associate in the department of comparative and human anatomy, but for several preceding years he had cooperated with the departments of vertebrate paleontology and comparative anatomy, making researches pertaining to the brains of fossil mammals and of prehistoric man. When the museum series of James Arthur annual lectures on the evolution of the human brain was inaugurated in 1932, he delivered the first lecture. During the past year he had planned a comprehensive research program, centering more of his endeavors than previously at the museum.

In the larger world of science and medicine, Dr. Tilney was among the few eminent neurologists. His more formal activities were those of practicing physician, consultant in neurology to several hospitals, professor of neurology and neuroanatomy at the College of Physicians and Surgeons of Columbia University, and medical director of the Neurological Institute of the New York Medical Center. A number of important research projects were actuated or directed by him. His enthusiasm for investigation led him to make significant and outstanding contributions, not only in the clinical and social aspects of neurology, but in studies of brain development, structure and function; sensory analysis; the evolution of the brain with relation to behavior and intelligence; and also to point out the philosophic implications of such studies. Besides numerous scientific papers published in journals and periodicals, he was the author of three important works on the brain. "The Form and Functions of the Central Nervous System" (in collaboration with Professor H. A. Riley), first published in 1920, serves as one of the more comprehensive text-books on the subject. "The Brain from Ape to Man," a monumental work in two volumes, published in 1928, is a comparative study of the brains of man and other primates, focused to illuminate the evolution and development of the human brain. "The Master of Destiny," published in 1930, is a popular presentation of the evolutionary history of the human brain—"a biography of the brain"—with some chapters of estimates, judgments and evaluations.

Aside from his scientific work, Dr. Tilney was a scholar in the liberal sense, with an eager interest in the arts and humanities. He was modest, simple, direct and sincere. Perhaps even more than for his work he was respected for unusual personal qualities. His colleagues, associates and acquaintances came to regard him with esteem and affection because of his inspiring courage, his wisdom and his gentleness. His superb life will endure in his achievements, but also in the hearts of his friends. His character seems peculiarly well portrayed by the following passage from Marcus Aurelius Antoninus, for whose observations he had remarked pleasure and respect:

> One man, when he has done a service to another, is ready to set it down to his account as a favor conferred. Another is not ready to do this, but still in his own mind he thinks of the man as his debtor, and he knows what he has done. A third in a manner does not even know what he has done, but he is like a vine which has produced grapes, and seeks for nothing more after it has once produced its proper fruit. As a horse when he has run, a dog when he has tracked the game, a bee when it has made the honey, so a man when he has done a good act, does not call out for others to come and see, but he goes on to another act, as a vine goes on to produce again the grapes in season. . . .

GEORGE PINKLEY
AMERICAN MUSEUM OF NATURAL HISTORY

RECENT DEATHS AND MEMORIALS

DR. THOMAS LYTTLETON LYON, professor emeritus of agronomy at Cornell University, died on October 7 at the age of sixty-nine years.

JOHN WILLIAMS DAVIS, of Petersburg, Va., consulting engineer with the Atmospheric Nitrogen Corporation and the Solvay Process Company, known for his work on the separation of helium from natural gas and on nitrogen fixation, died on October 4 at the age of fifty-one years.

THE Yale University School of Medicine has arranged an exhibition in recognition of the two hundredth anniversary of the death of Herman Boerhaave, who occupied the chairs of clinical medicine, botany and chemistry at the University of Leyden during some twenty years of his life. The books written by Boerhaave which are on exhibition come from the library of Dr. John F. Fulton, Sterling professor of physiology. The exhibition will be left in place until October 15 in the foyer of Sterling Hall of Medicine. There is exhibited the first edition of Boerhaave's "Institutiones Medicae," published in 1708, which for the first time established physiology as an academic discipline in the medical curriculum. "Institutiones Medicae" was written by Boerhaave to give his students a background of knowledge of normal function; in the work he introduces the term "physiology" in its modern connotation.

SCIENTIFIC EVENTS

WORK OF THE BRITISH HYDROGRAPHIC DEPARTMENT

The annual report of the Hydrographer of the Navy, Rear-Admiral J. A. Edgell, for 1937, summarized in the London *Times*, shows that the Service surveyed during the year a total length of 667 miles of coastline and sounded an area of 6,599 square miles. Seven ships were employed, three in home waters and four in foreign stations. In addition a surveying unit was employed on the West Coast of Scotland on a survey from Loch Killisport to Loch Crinan, and also surveyed Lake Windermere. The South Coast of England survey continued its work at Portsmouth, the Solent and Plymouth.

Provision has been made in the 1938 estimates for a new 53-foot surveying launch, equipped with echo sounding gear, for use by the latter survey. The tidal stream survey of the waters surrounding the British Isles, begun in 1933, was continued, observations being made by surveying vessels at 26 stations, at one station by the Southampton Harbor Board, and at 15 stations by the French Hydrographic Society.

Work on four new ships for service in home waters and two for service on foreign stations was continued, in addition to the Royal research ship *Research*. The keel of the latter was laid on September 9, 1937, and satisfactory progress has been made since that date.

A statistical summary shows that 63 new charts (compared with 29 in 1936) were published for general use, and 49 new editions of charts (compared with 45 in 1936). The number of corrections to charts inserted by hand was 259,888. The department issued 2,472 Admiralty notices to mariners during the year. The net receipts from the sale of charts amounted to £67,727, compared with £51,351 in 1936.

There was again an increase in the number of rocks and dangers to navigation discovered by surveying ships, the total being 135, against 112 in 1936, and 53 in 1935. In addition, 21 were reported by other British warships and 302 by various British and foreign governments and authorities, making a total of 458, against 435 in 1936 and 358 in 1935.

The number of broadcast wireless navigational warnings issued was 541, being larger than ever before and 49 more than in 1936. These reports are telegraphed from the Admiralty to various wireless stations in the British Isles, and are broadcast from these stations according to the area affected by the warning.

THE CHILDREN'S HOSPITAL RESEARCH FOUNDATION

Announcement is made by Dr. A. Graeme Mitchell, director of the Children's Hospital Research Foundation, Cincinnati, and Dr. Glenn E. Cullen, director of laboratories, that upon authorization of the board of trustees a Scientific Advisory Council has been appointed. This consists of:

Dr. O. T. Avery, member of the Hospital of the Rockefeller Institute for Medical Research.

Dr. Ernest Goodpasture, professor of pathology, Vanderbilt University School of Medicine.

Dr. A. Baird Hastings, professor of biological chemistry, Harvard University Medical School.

Dr. A. N. Richards, professor of pharmacology, University of Pennsylvania School of Medicine.

The second meeting of this council was held in Cincinnati on September 28 and 29.

The Children's Hospital Research Foundation was established in 1929 through the generosity of William Cooper Procter. Its facilities include its own laboratory building and affiliations with the Children's Hospital of Cincinnati, the Pediatric Department and the Contagious Disease Pavilions of the Cincinnati General Hospital, the Children's Convalescent Home, the Babies' Milk Fund Association and the Ohio Soldiers' and Sailors' Orphans' Home at Xenia, Ohio. The Children's Hospital and its Research Foundation are affiliated by agreement with the University of Cincinnati, the professor of pediatrics in the University of Cincinnati being the director of the medical service and the director of the foundation. Approximately one hundred and fifty publications have appeared from the research foundation. Present plans contemplate additions to the staff and certain new lines of investigation.

REORGANIZATION OF THE U. S. DEPARTMENT OF AGRICULTURE

Secretary Henry A. Wallace has announced important changes in the structure of the U. S. Department of Agriculture. These are designed to expedite the services of the department to the public. The new organization unifies four lines of work which have assumed importance in recent years as new responsibilities have been laid on the department.

(1) The forming of programs and plans to guide the entire group of agricultural adjustment, conservation and marketing services to farmers and the general public is assigned to the Bureau of Agricultural Economics, which will be charged with department-wide responsibility.

(2) The execution of marketing work is lodged in four units responsible to the secretary through a director of marketing and regulatory work.

(3) The execution of all physical land-use programs which involve operations by the Government on farm lands is consolidated in the Soil Conservation Service.

(4) Research work in the field of agricultural and in-

dustrial technology is placed under unified direction.

To direct the planning work Dr. H. R. Tolley, administrator of the Agricultural Adjustment Administration, formerly director of the Giannini Foundation of the University of California, has become chief of the reconstituted Bureau of Agricultural Economics.

Secretary Wallace, according to the official announcement, said:

> It is imperative that we establish over-all planning work for the whole department in order to provide for proper functioning of the many new activities authorized in recent years by the Congress. It has become all the more necessary since the department last July entered into a significant and far-reaching agreement with the Land Grant College Association. Under the agreement the colleges and the department are establishing democratic procedure that will give farm people an effective voice in forming, correlating and localizing public agricultural programs. Farm people and official agencies in the states are now forming community, county and state groups to carry on land-use planning and program building. In the expanded Bureau of Agricultural Economics, the department is now establishing its part of the machinery needed to integrate state and local planning with general planning and program-forming activities within the department.

To consolidate the marketing work, A. G. Black leaves the post of chief of the Bureau of Agricultural Economics and becomes director of the Bureau of Marketing and Regulatory Work. His associates, the chiefs of the four agencies combining all marketing and regulatory activities, will be: Jesse W. Tapp (formerly assistant administrator of the AAA), surplus commodity diversion and marketing agreements programs; C. W. Kitchen (formerly assistant chief of the Bureau of Agricultural Economics), marketing research, service and regulatory work; J. W. T. Duvel, continuing as chief, Commodity Exchange Administration; and Joshua Bernhardt, continuing in charge of activities under the Sugar Act of 1937. R. M. Evans leaves the post of assistant to the secretary and becomes administrator of the Agricultural Adjustment Administration.

The consolidation of physical operations in land-use programs for farm land brings them all under H. H. Bennett, chief of the Soil Conservation Service. Widening the uses of farm products is the purpose of merging technological research work, including that in the Bureau of Chemistry and Soils and that in the Bureau of Agricultural Engineering, under the direction of the chief of chemistry and soils, H. G. Knight.

THE DEDICATION OF THE ABBOTT LABORATORIES

The fiftieth anniversary of the founding of the Abbott Laboratories, pharmaceutical manufacturers, in North Chicago, was celebrated on October 7 with the dedication of a new laboratory building.

There was a special program in the afternoon, following an inspection tour in the morning. The speakers and their subjects were: Dr. Karl T. Compton, president of the Massachusetts Institute of Technology, "The University and the Public Welfare"; Dr. Herbert M. Evans, Morris Hertzstein professor of biology at the University of California, "The Task and Spirit of Research," and Dr. Thomas Parran, surgeon general, U. S. Public Health Service, Washington, D. C., "Research and Public Health." In the evening a program was presented at the Palmer House with the following speakers: Dr. Harrison E. Howe, editor of *Industrial and Engineering Chemistry*, "The Contributions of Organized Chemistry"; Dr. George D. Beal, assistant director of the Mellon Institute, Pittsburgh, "The Scientific Development of Drug Standards"; Dr. Morris Fishbein, Chicago, editor of the *Journal* of the American Medical Association, "The Contributions of Medicine to the Public Welfare."

The new building is three stories high with an attic and basement, providing facilities for the chemical, bacteriologic, botanic, medical and pharmaceutic research activities of the firm. In addition to laboratories it contains a micro-analytic laboratory, a library with accommodation for 20,000 volumes, hot and cold rooms for stability studies, dark rooms on each floor for the use of optical instruments, one dark room for use as a laboratory for light-sensitive reactions and an air-conditioned auditorium seating 800 persons.

THE AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE

At its annual meeting each year the council of the association votes a number of grants in aid of research. In order that applications for such grants may be examined and passed on by the committee on grants in time for the annual meeting, they must be filed in the office of the permanent secretary before November 1 on forms that will be supplied upon request. These forms contain full instructions respecting the information that must support the applications.

The funds from which the grants are made are derived from the income of endowments of the association by various gifts, from investments of reserve funds and from the income from the life membership fees of deceased life members. Although the income available for the support of research is as yet very limited, it fortunately has been increased in recent years by gifts from a friend of the association.

As a rule grants are not made to pay salaries of investigators or traveling expenses or for printing reports of the results of investigation. They are generally made for assistance in completing research projects that are well under way and for which valuable conclusions within limited periods may reasonably be expected. Often they complete the requirements for funds which have been partly met by the institutions with which the applicants are associated or from other sources.

Section I (Psychology) of the association will meet in Richmond, Va., from Tuesday, December 27, to Thursday, December 29. In addition to the usual program of contributed papers, there will be, on Wednesday, December 28, a symposium on "Recent Advances in the Psychology and Physiology of Audition" under the chairmanship of Dr. Elmer A. Culler, University of Rochester.

Since the change of the date of the meetings of the American Psychological Association from Christmas to September, attendance at the meetings of Section I has steadily increased. It is hoped that a large number of psychologists will attend and participate in the Richmond meetings. The character of the general program must depend on the submitted papers, and members of Section I are urged to send in abstracts. Both theoretical and experimental papers are acceptable.

All fellows and members of the section who wish to read papers should submit abstracts in duplicate (not more than 300 words in length) of the papers which they wish to present. Please note on the abstracts the time required for presentation up to a limit of 15 minutes. Abstracts should reach the section secretary, Leonard Carmichael, Tufts College, Medford, Massachusetts, not later than November 11.

F. R. Moulton,
Permanent Secretary

SCIENTIFIC NOTES AND NEWS

The Perkin Medal of the Society of Chemical Industry for achievement in industrial chemistry has been awarded to Dr. Walter S. Landis, vice-president of the American Cyanamid Company.

Dr. Nevin M. Fenneman, professor of geology and geography at the University of Cincinnati, will be presented with the gold medal award of the Geographic Society of Chicago on October 22 at the annual post-vacation luncheon of the society.

At the opening exercises of the Medical School of the University of Michigan on October 1, the degree of doctor of science was conferred upon Dr. Peyton Rous, member of the Rockefeller Institute for Medical Research, New York, who delivered the convocation address.

The Harvard Alumni Bulletin reports that in honor of Dr. Walter B. Cannon, George Higginson professor of physiology at the Harvard Medical School and national chairman of the Medical Bureau to Aid Spanish Democracy, a fund is being raised by his friends for relief work in Spain. The money will be sent this month, together with a portrait of Dr. Cannon, to Dr. Juan Negrin, premier of Spain, professor of human physiology at the University of Madrid and director of the physiological laboratory of the Ramón y Cajal Institute, a friend of Dr. Cannon.

Dr. Albrecht Penck celebrated his eightieth birthday on September 25. Professor Penck held for twenty years the chair of geography at the University of Vienna, when in 1906 he was appointed to take charge of the Museum of Marine Studies in the University of Berlin. In 1922 he was made director of the Institute of Geography of the university, becoming emeritus in 1927.

It is reported in *Nature* that Professor Alfred Kühn, director of the Kaiser-Wilhelm Institute of Biology, Berlin; Dr. Hugo Hassingen, professor of geography at the University of Vienna, and Dr. Hans Ahlmann, professor of geography at Stockholm, have been elected members of the Prussian Academy of Sciences in the physico-mathematical class.

Dr. Harold C. Urey, professor of chemistry at Columbia University, will give the George F. Baker lectures in chemistry at Cornell University for the academic year 1938–39 in November and December. Dr. G. B. Kistiakowsky, of the department of chemistry at Harvard University, will be Baker lecturer in February and March, and Dr. P. W. Bridgman, professor of physics at Harvard University, will lecture in April and May.

Dr. Thomas Francis, Jr., member of the staff of the International Health Division of the Rockefeller Foundation, in charge of research on influenza, has been appointed professor of bacteriology in the New York University College of Medicine. The chair in bacteriology became vacant recently when Dr. William S. Tillett was assigned to the professorship of medicine formerly occupied by the late Dr. John Wyckoff.

Dr. Hiram Bentley Glass, of Stephens College, Columbia, Mo., has been appointed assistant professor of biology at Goucher College, Baltimore.

Dr. S. C. Werch, demonstrator in physiology at the School of Physic, Trinity College, Dublin, has been appointed instructor in the department of pharmacology in the Medical College of the State of South Carolina.

Dr. W. G. Clark, of the Scripps Metabolic Clinic, La Jolla, Calif., has been appointed instructor in the department of zoology at the University of Minnesota.

Dr. I. M. Kolthoff was referred to in a recent issue of Science as head of the department of chemistry at the University of Minnesota. His correct title is chief of the division of analytical chemistry.

R. W. Trullinger, principal experiment station administrator and agricultural engineer, who has been associated with the Office of Experiment Stations of the U. S. Department of Agriculture since 1912, has been appointed to the newly established position of assistant chief. His work will be, in association with the chief, to "direct and supervise the administration of the Federal Acts granting funds to the states for research with all correlated responsibilities and to assume leadership in the maintenance of desirable research relationships between states and between state and Federal agencies with respect to these Federal-grant Acts."

H. C. Sampson retired from the post of economic botanist at the Royal Botanic Gardens, Kew, on September 30. He is succeeded by Sir Geoffrey Evans, who is retiring from the post of principal of the Imperial College of Tropical Agriculture, Trinidad. He has in turn been succeeded in the principalship by O. T. Faulkner, director of agriculture in Nigeria.

Dr. M. S. Krishnan has been appointed assistant director of the Geological Survey of India. He is the first Indian to be appointed to this post.

The following fellows in the medical sciences, appointed by the Medical Fellowship Board of the National Research Council during the year 1938–39, have commenced their fellowship appointments: Louis K. Alpert, at the Rockefeller Institute for Medical Research; Philip P. Cohen, at the University of Sheffield (England); Thomas H. Davies, at California Institute of Technology; Carl L. Larson, at the University of Rochester; Arthur P. Richardson, at the Johns Hopkins University; Jane A. Russell, at Yale University; Wilfred W. Westerfeld, at the University of Oxford.

Dr. W. F. Prouty, head of the department of geology of the University of North Carolina, has been made a member of the Board of Consultants of the Tennessee Valley Authority in place of Professor W. J. Mead, of the Massachusetts Institute of Technology, who recently resigned.

Dr. Paul R. Cannon, professor of pathology of the University of Chicago, has been appointed a member of the Medical Fellowship Board of the National Research Council for the period ending June 30, 1941, to complete the unexpired term of Dr. Eugene L. Opie, who has resigned.

Elmer H. Johnson, industrial geographer in the Bureau of Business Research of the University of Texas, has been given leave of absence to make a study of regional industrial development in a group of southeastern states.

Dr. Forest Ray Moulton, permanent secretary of the American Association for the Advancement of Science, will open the annual lecture series of the Louisiana State University chapter of Phi Kappa Phi on October 27.

At the inauguration of the one hundred and fourteenth annual session of the Jefferson Medical College, Philadelphia, the introductory lecture was delivered by Dr. Charles M. Gruber, professor of pharmacology, on "Research, the Key to Progress."

Sir Edward Mellanby will deliver the Harveian Oration to the Royal College of Physicians of London on October 18.

The two hundred and twenty-third regular meeting of the American Physical Society will be held at the University of Chicago on Friday and Saturday, November 25 and 26. The headquarters hotel will be the Hotel Windermere.

The annual meeting of the Air Hygiene Foundation will be held on November 17 at the Mellon Institute, Pittsburgh. The program includes progress reports on the research for preventing industrial disease and improving the health of employees. Other reports, for industrial management, will cover legal, economic and social phases of industrial health.

The fifth annual meeting of the New York State Geographical Association will be held at the State Teachers College at Buffalo on November 5. In the morning session, papers on the geography of New York State will be presented. A field trip is planned for the afternoon, with a banquet and an invited speaker for the evening.

Bradford Willard, press secretary of the Pennsylvania Academy of Science, reports that the regular summer meeting of the academy was held on August 12 and 13 in Chester County. Seventy-five members and guests attended. The academy assembled at Coatesville on the twelfth in the afternoon and proceeded on a field trip. Two hours were spent in the du Pont Longwood Gardens, where items of unusual botanical interest were observed. From the gardens, the trip continued through the region of ancient, crystalline rocks where both geology and botany proved interesting. Particularly striking was the difference between the vegetation of the serpentine barrens and intermingled areas of pegmatite. A business meeting and reception occupied the evening. The last day was devoted to further field studies. The first stop was the arboretum of the Westtown School. Following that parties visited the serpentine barrens, Woods Chrome Mine and other points, chiefly of interest to the mineralogist and botanist. The Chester County Natural Historical Society, Dr. E. T. Wherry, of the University of Pennsylvania, and Dr. E. M. Gress, state botanist of Pennsylvania, were largely responsible for the successful planning and conducting of the meeting and field trips.

The fourth annual fall Field Camp of the department of geology and geography of Syracuse University was held in the vicinity of Catskill, New York, from September 12 to 17, under the direction of Dr. George B. Cressey, chairman of the department. Headquarters were at the Kiskatom, a country hotel near Palenville.

The first meeting of the London Scientific Film Society was held on September 20. The society plans to give a series of shows of scientific films to its members and their guests during the coming season. Professor Sir Frederick Gowland Hopkins, Sir William Bragg, Professor L. Hogben and Professor Julian Huxley are patrons of the society, which has about a hundred and fifty members.

George A. Hormel and Company, of Austin, Minn., has made an annual grant of $25,000 to the University of Minnesota to establish the Hormel Research Foundation for the promotion of researches in the field of food technology. Most of the research will be devoted to problems of importance to the packing industry. The work will be conducted by a committee consisting of Professors George O. Burr, R. A. Gortner, H. O. Halvorson, Walter M. Lauer and Samuel C. Lind, chairman. The post-doctor of philosophy fellows who will take part in the research in 1938–39 are: Claude H. Hills (biochemistry); J. P. Kass (biochemistry); Lewis S. Keyser (organic chemistry) and Floyd C. Olson (industrial bacteriology).

Under the terms of the will of the late Miss Grace M. Edwards, of Boston, the president and fellows of Harvard College will receive $25,000 for the benefit of the Arnold Arboretum.

Free illustrated lectures at the New York Botanical Garden have been announced for three o'clock on Saturday afternoons as follows: October 1, Rock Garden Construction, A. C. Pfander, assistant superintendent; October 8, Humoring the Garden Soil, T. H. Everett, horticulturist; October 15, Botanists and Human Progress, J. H. Barnhart, bibliographer; October 22, Winter in Oaxaca, W. H. Camp, assistant curator; October 29, Garden Work with Shrubs, P. M. Koster, nurseryman; November 5, Some Important Drug Plants, Professor Wm. J. Bonisteel, Fordham University; November 12, Alpine Flowers of Central Greece, Professor Clarence H. Young, Columbia University, and Mrs. Young; November 19, Origin and Improvement of Plants, A. B. Stout, curator of education and laboratories; November 26, The Romance of Plant Names, H. A. Gleason, head curator and assistant director.

An Associated Press dispatch dated from Berlin on October 4 reads: "German medical journals no longer may accept articles by Jewish doctors, the Nazi Commissioner for Medical Journalism ordered. The order added that 'our German doctors will subscribe to foreign journals only if they are published by Aryan publishers and edited by Aryan doctors.'"

DISCUSSION

AN INSTANCE OF PROGRESSIVE INDIVIDUATION IN VISUAL FUNCTIONS

This is simply an anecdote. It is utterly lacking in scientific control, but, like all such incidents, it had to be "caught on the fly" and taken for what it is worth. At least it serves to illustrate what I mean by individuation in the sensory field.

The incident which I am about to relate concerns my dog, Ponto. In breeding he is three fourths German police and one fourth Scotch collie. I procured him when he was ten weeks old, and till this incident kept him tied most of the time. Occasionally when I was going about the premises I turned him loose, and particularly I did so each morning when I went for my mail at the rural delivery box. This is south of the main entrance to my laboratory. These daily trips were occasions of great joy to Ponto, as he showed by leaping upon me, and especially by taking the lower end of my cane in his mouth and playing with it, then dropping it only to catch it up again. He obviously regarded my cane and myself as friendly creatures.

This went on for about four weeks, when Ponto had a new and strange experience with me and my cane. Instead of going out of the south door of my laboratory I went out of the west door. Ponto, being free, met me instantly and took the tip of my cane in his mouth as usual. He played about my feet as I walked along till we passed the servants' quarters to the northwest and entered the poultry yard beyond, the poultry yard being so situated as not to be visible from the west door of my laboratory on account of the servants' quarters. When we entered the poultry yard Ponto set upon the hens and gave them a merry chase. To chastise him I reprimanded him loudly and threw my cane at him. He fled precipitately and ran out of danger back to the laboratory.

The next morning Ponto met me as usual at the front door for the excursion to the mail box. He made the customary salutation and played with my cane as I walked along. There was nothing in his behavior to indicate that he remembered the incident of the day before in the poultry yard or regarded either myself or my cane as a menace. But later the same day I went out of the west door of my laboratory again on my way to the poultry yard. Ponto met me at the door and, taking the tip of my cane in his mouth, played along happily till we passed the servants' quarters and came in view of the poultry yard. At that moment he stopped and seemed to survey the situation. His ears and tail drooped disconsolately, and, turning about, he went sorrowfully back to the laboratory. These reactions were repeated for several days following.

Now, the poultry yard had done nothing to chastise Ponto. It was myself and my cane that had functioned in that capacity. According to the theory of association the dog would be expected to associate (synthesize) the chastisement with me and my cane, the moving objects which overtly effected the reprimand. But, obviously, my cane and I held no menace for him so long as we were alone in his field of vision. As soon, however, as we made a common visual pattern with the poultry yard he recognized a menacing situation. It was the total pattern that acted as the stimulus. And this did not require an act of synthesis by Ponto. The totality (oneness) was primary, and in the primary total visual pattern none of the elements had acquired a sufficient degree of individuality of their own for the dog to recognize them as such in the composition of the field and to attach to them their true significance. In other words, Ponto could not individuate my cane, myself and the poultry yard.

But Ponto's behavior when he was six months old suggested that he had made progress in powers of visual individuation. He would then seat himself before me while I stood quietly, and would gaze into my eyes intently and inquiringly as if he expected something to come out of them. He had obviously noticed that my eyes were a part of me, and a very special part, for after we had looked each other straight in the eyes for a while, and without either of us making any other movement, he would playfully leap at my face. This leap was so sudden and close that I had to dodge to escape it.

Possibly I owe psychologists an apology for this trespass upon their field, particularly those who give little consideration to neurology or have no sympathy for Gestalt psychology. Kuo,[1] for instance, has criticized my "uncritical acceptance of the 'gestalttheorie.'" This does not seem to me quite justified, for I had not thought of accepting any theory of psychology. In fact I have not studied the theory of Gestalt in its broader implications. But I am in agreement with the theory in the interpretation of the relation of the part to the whole in organismic behavior. And in so far as I have advocated the theory I have been impelled by facts of structural and functional growth of the nervous system and the organism. In both structural and functional development I see the antagonistic processes of integration and individuation; the one tending to maintain the integrity of the organism, the other tending to dismember it. Normal development requires the whole to dominate the parts. If this is in accord with the *"gestalttheorie,"* as I think it is, all well and good, but beyond this I have no personal interest in the theory.

Within normal limits individuation makes for greater efficiency of living, both motor and sensory. In the visual functions I consider it as the biological process which makes possible a figure on a ground. Genetically, we see, first, totalities (wholes); later we "regard" parts of the totalities. It is possible that Ponto in his younger days saw my cane as a part of myself, for he was constantly trying to lick my hands, though I avoided this caress as much as possible and reproved him for it. Taking the tip of my cane in his mouth may have given him a similar satisfaction, and he could do this with impunity. Only later, I think, was he able to "regard" my cane as such; for this would be possible only through the process of individuation. In former writings I have spoken of this process as "reduction" of the field of stimulation,[2] or "progressive restriction of the stimulogenous zone,"[3] or "progressive reduction in the extent of the reflexogenous zone or range of the impinging stimuli."[4]

In this as in all my communications I take pleasure in acknowledging a grant by the Josiah Macy, Jr., Foundation to support my work.

G. E. COGHILL

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STROBOSCOPIC ILLUSIONS CAUSED BY LIGHTNING

ON June 10, 1938, a thunder-storm lasting from 5:30 to 7:30 P.M., accompanied by brilliant lightning, occurred at Iowa City, Iowa. The sky, piled high with white cloud masses, was brightly illuminated at frequent intervals during this storm. An 8-inch electric fan running on a window sill facing the storm was sharply silhouetted against this light background throughout each flash. Lasting through many flashes a brief stroboscopic illusion was noted on the revolving fan blades. This was more clearly seen with the room lights turned off. Every stroke did not produce exactly the same illusion on the fan blades. A number of flashes caused the revolving blades to appear practically motionless; with others they seemed to revolve slowly in the direction of their original rotation. Some flashes produced no effects. During the present observations it was estimated that at least 80 per cent. of the flashes created a stroboscopic illusion upon the whirling fan blades. Noticeable flickering of the flash frequently characterized those strokes creating this illusion. No flashes were observed that caused the fan blades to appear to revolve backwards.

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[1] Zing Yang Kuo, *Psychological Review*, 39: 499–515, 1932.

[2] G. E. Coghill, *Proc. Nat. Acad. Sciences*, 16: 637–643, 1930.

[3] *Ibid.*, *Archives of Neurology and Psychiatry*, 21: 989–1001, 1929.

[4] *Ibid.*, *Jour. Gen. Psychol.*, 3: 431–435, 1930.

Recent researches upon lightning by McEachron and McMorris[1] have demonstrated that what appears to be a single stroke is often a series of flashes, spaced a fraction of a second apart. Such multiple strokes may consist of as many as 40 separate discharges, the interval between them varying from 0.0006 to 0.53 second. Their observations have indicated that about 90 per cent. of the strokes in some storms were multiple. This paper should be consulted for details impossible to cite in a short note.

These researches have clearly indicated that certain bolts of lightning are made up of a rapidly occurring series of separate flashes. A multiple stroke of lightning may, therefore, create the same type of illusion upon the revolving blades of an electric fan as do the intermittent light flashes produced by a stroboscope.

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ADVANTAGES OF $F_g = kma$

The much-debated and troublesome gravitational measure of force can be handled in only two essentially different ways. These are $F_g = kma$ and $F_g = \frac{wa}{g}$. Each has its advantages and each has its ardent advocates, so that further discussion may be a waste of time. However, I should like to point out one or two possibly new reasons which seem to me to give the weight of argument in favor of *kma*.

In this method k is a numerical constant which, in the metric system, converts dynes to grams of force (F_g). In the form $F_g = kma$, it equals approximately 1/980 and is exactly analogous to the number 12, which converts a length measured in feet to the same length measured in inches. Such a number has no dimension as the word is usually understood. It is simply the quotient of one foot divided by one inch. The result is twelve, not 12 *in/ft*. If you ask how many quarters make a dollar, the answer is four, not 4 quarters/dollar. The latter would amount to saying: "four quarters per dollar quarters make a dollar"; which is certainly redundant. Thus we may write $L_{in} = 12L_{ft}$, or $F = 980\ F_g$, where 12 and 980 are numerical ratios of the same physical quantity, and are therefore numbers having no dimensions.

The other method is based on a force-length-time system of units instead of a mass-length-time system. The force (weight) w is converted to a mass by dividing by g, and this new mass, measured in units of 980 grams, gives force in grams when multiplied by the acceleration measured as usual. The numerical labor involved is identical in both methods, so the only question is as to which makes for the least confusion. It seems to me that *kma* is the least confusing, since it does not depart from the c.g.s. system in calculating the non-c.g.s. quantity, force measured in grams. The trouble with $F_g = \frac{wa}{g}$ is that it introduces practically two non-c.g.s. quantities, namely the weight w, and the mass w/g measured in 980-gm units. Possibly this system would be preferable if we always used gravitational units and nothing else. That is why it appeals to the engineer, who clings to the good old pound weight and ignores the possibility of a pound *mass*. But the use of the metric system either with c.g.s. or m.k.s. units is certainly increasing. So it seems to me that since we can not yet ignore force pounds and force grams, we should use that method of dealing with them which is the least confusing and which deviates as little as possible from the concept of force expressed by $F = ma$.

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QUOTATIONS

THE PHYSIOLOGICAL CONGRESS AT ZURICH

Amid auspicious surroundings the International Physiological Congress had its sixteenth, or jubilee, meeting at Zurich from August 14th to 19th. The president, Professor W. R. Hess, in a happy address of welcome, pointed out that the congress had been conceived in England in 1888, but was born at Basel in September of 1889 when a group of 129 physiologists met to hold their first congress. It was highly fitting, therefore, that the congress should return to Switzerland to celebrate its fiftieth anniversary; this time with a registration of more than 1,600 members.

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[1] K. B. McEachron and W. A. McMorris, *General Electric Review*, 39: 487–496, 1936.

In recognition of the occasion the Physiological Society had appointed Dr. K. J. Franklin to write "A Short History of the International Congresses of Physiologists." This excellent record appeared in the *Annals of Science* for July 15th and in reprint form was presented by the society to all members of the congress. The "History" is appropriately dedicated to "Charles Scott Sherrington, one of the general secretaries of the congresses from 1892 to 1907, who by his experimental demonstrations at successive meetings and by his personal encouragement of younger physiologists has for half a century put into practice the principles laid down by the founders of the congresses."

The Zurich congress was notable for its observance of the principles of simplicity which Michael Foster and others insisted upon at the early congresses: a minimum of pomp and ceremony, no official delegates, quiet entertainment, often *en famille*, and a sympathetic and well-mannered press. The scientific proceedings were marvellously organized in five simultaneous programs beginning on Monday afternoon, August 15th, and continuing twice daily (save for the excursion on Wednesday afternoon) until Friday afternoon. A new and highly successful feature of the congress were the fifteen symposia embracing set topics of current interest such as the kidney, acetylcholine, fœtal respiration, adrenal cortex and vitamin B_2, at which the major contributions and principal discussions were by invitation. There were also many demonstrations, conspicuous among which was evidence of the growing popularity ot cinematographic demonstration.

Scientifically speaking, it was generally felt that the Zurich congress was the most successful of any held in recent years, and it set a standard which English members will find it difficult to equal in 1941 when the seventeenth congress is to meet in Britain. From the international standpoint there were several features worthy of note. It was a source of profound regret, after the brilliant congress at Leningrad and Moscow in 1935, that not one Russian physiologist could be present in Zurich. Professor Orbeli, however, was elected to succeed Pavlov on the international committee, and it is earnestly hoped that we shall be able to welcome him and his colleagues in England in 1941. A source of gratification to the entire congress was the large delegation of physiologists from Spain, led by Professor Negrin himself and including Professor August Pi Sunyer of Barcelona and Professor Jaime Pi Sunyer of Santiago de Galicia. The German delegation was unexpectedly large, consisting of 130 members, though many eminent physiologists of Germany (including Bethe, Warburg, von Brücke and Otto Loewi) were conspicuous by their absence. Drs. Oskar and Cecile Vogt happily were present in Zurich. Apart from several junior students from European laboratories, only one physiologist came from the Far East (Professor Yas Kuno).

For its skill in handling the problems of diplomacy with which the congress was faced the Swiss committee deserves the admiration and gratitude of all those interested in the welfare of physiology; and in this connection the names of Professor Hess and of Professor Ernst Rothlin, the general secretary, come most prominently to mind, together with that of their able assistant, Dr. Oskar Wyss. After unanimously voting to accept the invitation to meet in England in 1941, the congress responded enthusiastically to Professor Houssay's invitation to meet in Buenos Aires in 1944; the South American invitation, however, will not be voted upon until 1941.—*Correspondent of The Lancet.*

SCIENTIFIC BOOKS

PHYSICS TEACHING AND THE TEXT-BOOKS

USUALLY at the beginning of the academic year a great variety of new texts, or new editions of surviving old-established text-books, arrive in astonishingly large numbers. The diversity of objectives and expectations of a physics course is probably the main reason for this flood of texts which attempt to satisfy the great differences of conditions to be met in this country. Physics is taught as a foundation for engineering and applied sciences, as a basis for natural philosophy, and finally as a part of the general survey course on the natural sciences which is becoming increasingly popular in secondary schools and colleges.

Depending on the purposes of the course as set by the instructor, the outlook on the subject is bound to vary. But the reason for the appearance of so many different texts is due not only to the different fundamental concepts or minimum requirements of a general physics course, but also to the variety of entrance requirements into colleges which exist in different parts of the country and in different schools. From those students who have had no high-school physics at all and hear about physics for the first time in the sophomore year, to those students who have had one year or more of college work and are required to take two years of physics, all intermediate stages are encountered. It is, therefore, to be understood that no two texts are alike and that in most cases each book will appeal to some special group only. Some of the texts submitted in Table 1 are written by authors long versed in undergraduate teaching in this country, while others are of English origin. The main difference between

TABLE 1

Author	Title	Year	Publisher	Price
Bidwell and Bayley	Physics	1936	Macmillan	$3.50
Bowden, A. T.	Man's Physical Universe	1937	Macmillan	
Champion and Davy	Properties of Matter	1937	Prentice-Hall	4.50
Culver, C. A.	A Textbook of Physics	1936	Macmillan	4.00
Edser, E.	Heat for Advanced Students	1936	Macmillan	1.75
Eldridge, J. A.	College Physics	1937	Wiley and Son	3.75
Erickson, H. A.	Elements of Mechanics—3rd Ed.	1936	McGraw Hill	2.25
Fermi, E.	Thermodynamics	1937	Prentice-Hall	3.00
Filon, L. N. G.	A Manual of Photoelasticity for Engineers	1936	Cambridge Univ. Press	1.50
Fletcher-Mosbacher-Lehman	Unified Physics	1936	McGraw Hill	1.80
Hadley, H. E.	A Class Book of Magnetism and Electricity	1936	Macmillan: London	2.50
Hirst, A. W.	Electricity and Magnetism	1937	Prentice-Hall	4.50
Hobbie, J .R.	Introduction to College Physics	1936	Farrar and Rinehart	3.50
Jones, A. T.	Sound	1937	D. van Nostrand	3.75
Kimball, A. L.	College Physics—5th Ed.	1937	Henry Holt and Co.	3.75
McLachlan	Acoustics	1936	Oxford Univ. Press	2.75
Millikan, R. A., Roller, D.	Mechanics, Molecular Physics	1937	Ginn and Co.	4.00
Osgood, W. F.	Mechanics	1937	Macmillan: New York	5.00
Page, N. C.	Lessons and Problems in Electricity	1936	Macmillan	2.75
Ramsey, A. S.	Electricity and Magnetism	1937	Cambridge Univ. Press	3.25
Ramsey, A. S.	Hydrostatics	1936	Cambridge Univ. Press	2.35
Schrader, J. E.	Physics for Students of Applied Science	1937	McGraw Hill	4.00
Spinney, L. B.	A Textbook of Physics	1937	Macmillan	3.75
Timoshenko and Young	Engineering Mechanics—Statics	1937	McGraw Hill	2.75
Timoshenko and Young	Engineering Mechanics—Dynamics	1937	McGraw Hill	2.75
Vigoureux and Webb	Principles of Electric and Magnetic Measurements	1936	Prentice-Hall	5.00
Williams, S. R.	Foundations of College Physics	1937	Ginn and Co.	4.00

American and English texts lies in the different emphasis on modern developments. All American authors attempt to make the subject more interesting by stressing modern developments and emphasizing the importance of modern physics in its applications to other sciences and industry. This tendency, which we believe is sound and worth-while, is noticeably lacking in the English texts. It seems that our English colleagues stress mainly the fundamental concepts of physics as given by the framework of classical physics and leave modern developments almost entirely to graduate study.

The new tendency to offer physics as a part of a survey course in the general sciences is particularly striking in the new book by Bowden. This book, written in an interesting and easily readable style, should be excellent in the hands of an experienced teacher or, better still, of a group of teachers administering the course. For where can a teacher be found nowadays who has the self-confidence and training to teach all the subjects of geology, astronomy, physiology, chemistry and physics? Moreover, the book can hardly be recommended as a book which the student could use without the help of an instructor, since most of the developments are sketched so briefly that they require amplification in the lecture or recitation, and since many statements need clarification and correction.

Of the great number of general physics texts, many, like Spinney, Kimball, Hobbie and Culver, appear in new editions brought up to date and somewhat enlarged. Of the new texts the book of Eldridge is remarkable for its enthusiastic approach. Problems are well chosen, and everywhere the author has tried to emphasize the clarity of concepts and their mathematical developments. It is unfortunate, however, that in an attempt to avoid the introduction of "abstract" mechanics the author starts with elasticity and liquids, which can scarcely be properly understood without the knowledge of elementary mechanics. The general feeling seems to be that no student can be interested enough in the development of mechanics, and so consequently many text-books make the introductory chapter more "interesting" by dealing with material which logically could only be treated after the concepts of mechanics are fully understood. In this respect the book of Williams is a notable exception. Carefully arranged in logical order—see, for instance, the introduction of magnetism!—this author has given a clear outline of the principles of classical physics from a modern view-point. Excellent illustrations accompany the discussion, which is amplified by good problems and valuable exercises. While modern developments are taken into account everywhere, one feels that the treatment in some chapters is too cursory to be effective. Particularly the section on optics should be enlarged. The book seems particularly well adapted for use in a general science course.

If there is enough time available—and we believe there should be—then the method used by Millikan and Roller should be admirably suited to create more interest on the part of the student and teacher in the logical development of physical thought. To break the trend of abstract reasoning Millikan and Roller insert some chapters on historical developments. We found that students prefer this type of presentation, and we believe that a book of this caliber should be extremely useful in the teaching of both science and engineering students. However, we note with regret that in a book which is the first part of a two-year physics course no mention is made in the section on mechanics of the importance of *reference systems*. This material would help greatly in clarifying such concepts as centrifugal force, and would also be of advantage in the understanding of relativity later on. We also feel that in the part on heat some space should be devoted to the clarification of the concept of entropy, and in this way problems in thermodynamics could be handled with better understanding, and the connection of thermodynamics with the kinetic theory of matter would be made clearer.

The question whether calculus should be used in an elementary physics course is answered by different teachers in different ways according to the nature of the course. A two-year book, like the one of Millikan and Roller, and the more advanced text, like Bayley and Bidwell, have in this respect an advantage over texts which have to struggle with the derivation of physical concepts by circumventing calculus.

Nothing perhaps brings out more clearly the difference in material as the second-year books, which introduce the student to the different branches of physics in detail. Erickson's well-known text on mechanics is entirely elementary, so that it could be well used by a beginner. The books of Timoshenko and Osgood will require a broader background. Timoshenko's book (one of the few books to be recommended to the almost extinct species of student who studies independently), "Engineering Mechanics," is written for engineering students, but it will certainly be extremely useful in any intermediate course in mechanics. The large number of problems will help a great deal to understand the principles of mechanics and their application, and will be useful for any physics student who wants to gain a real working knowledge of mechanics. Osgood's book is of an entirely different character. In the preface Professor Osgood states that this book might be used in "a first course in mechanics given for sophomores," but where, oh, where is there a sophomore who has enough background to follow Osgood from the simplest concepts of mechanics to Hamiltonian dynamics? In most schools this book will serve well in a beginning graduate course. It is interesting in this connection to compare the training we offer in mechanics with that obtained in the English schools. A. S. Ramsey's book on "Hydrostatics" is a text-book for the use of first-year students in the universities and for the higher divisions in secondary schools. While the book is truly elementary in character (the problems are to be recommended to every physics teacher), there will hardly be any first-year students in our universities with enough training to use this book. Again it will be useful as a text in intermediate physics, especially in connection with Ramsey's other text on dynamics.

The subject of acoustics is treated only too briefly in most physics courses. A. T. Jones's book on "Sound" should appeal not only to the beginning physicist, but is simple enough to be used by a student of music who has had elementary physics. McLachlan in his new "Acoustics" stresses the applications of modern acoustical development in communication, broadcasting and transcribing music. He also gives an excellent introduction to the modern ideas about speech, and the book will be useful as a cross-reference in an elementary course in acoustics.

Edser's intermediate text on "Heat" has been somewhat enlarged and brought up to date. As such it will keep its place as a favorite with teachers and students.

Fermi's "Thermodynamics" is an elementary introduction which also gives some modern developments, but is rather condensed. While useful for an introductory course in thermodynamics, it needs a great deal of amplification on the part of the instructor to make the condensed treatment of value to the student. The problems are well chosen and interesting.

It is always a problem where to treat such subjects as capillarity, viscosity and diffusion properly. This gap is supposed to be filled by the text of F. C. Champion and Davy's "Properties of Matter." Modern developments are treated, and especially the chapters on capillarity should be useful. It contains, besides, such varied subjects as gravitation, elasticity, compressibility, seismic waves, method of determining Planck's constant, etc. While this variety may be useful for the book as a reference work, it is a handicap to use it as a text in a course.

As usual there are a large number of texts on electricity. For the beginner Ramsey's "Electricity and Magnetism" should be an excellent introduction to the more advanced text to be used in graduate courses. Hadley's book on "Electricity and Magnetism" is remarkable for the historical development, treated extremely carefully, and the good foundation it gives on the level of *high-school physics*. This illustrates again how much more training is required from the high-school student abroad as compared with the meager training we give in this country in high-school physics. The texts of Hirst and of Vigoureux and Webb are useful in the laboratory. It is somewhat startling to see that in Hirst's book, "Electricity and Magnetics," electrostatics is relegated to the very end of the book, which does not seem to be justified in view of the modern applications of electrostatics methods. Particularly useful are N. C. Page's "Lessons and Problems in Electricity." The material is not only well arranged, but the selection of problems and mathematical developments are such that both physics students and engineering students profit a great deal by its study.

Filon and Cooker published some years ago the standard work on photoelasticity. This book is used widely by engineers and physicists in industry for the investigation of strength of materials. There has been, however, a great need for a book describing in simple language the elements of photoelastic measurements, and this gap seems to be filled by Filon's "A Manual of Photoelasticity for Engineers." It gives first a short introduction of the physical fundamentals of photoelastic methods, and then applies this knowledge to the treatment of instruments and measurements.

The great productivity in the field of general physics texts and of many specialized advanced texts is of course stimulated by the interest in modern physics and physical research in this country. Still there exists a great gap which has not yet been filled between the introductory text and the specialized treatise. Any physicist who has occasion to discuss physical problems with chemists, biologists or engineers is often confronted with the following plea: The Germans have Kohlrausch's "Practical Physics" or Riecke's two-volume text on physics; physico-chemists, in this country, have the excellent work of Hugh C. Taylor and his collaborators; physiologists can refer to Bayliss's standard text, but there is no physics text, in the English language, of this character, a book that makes it possible for scientists working in other fields to obtain an adequate knowledge in physics beyond the elementary text and without going to specialized handbooks. May we express the hope that the American Physical Society and the Association of American Physics Teachers will soon find means to prepare a text-book in physics to meet this demand!

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SPECIAL ARTICLES

HETEROLOGOUS TRANSPLANTATION OF HUMAN AND OTHER MAMMALIAN TUMORS

Various claims to the successful grafting of human cancers to lower species of animals have not been substantiated by repetition, and at the present time the view generally held by workers in the field of cancer research is that such transplantation is impossible. In fact, the heterologous transplantation of tumors between even closely related species has met with little success. Murphy[1] was able to grow the Jensen rat sarcoma in developing chick embryos, and the successful transplantation of mouse carcinomata to rats has been independently reported by Shirai,[2] Putnocky[3] and others.

The transplantation of a uterine carcinoma of the rabbit into the anterior chamber of the eyes of other rabbits has been reported.[4] The ease with which the initial transplantation was made, in contrast to the complete failure of other modes of inoculation, suggested that this method might be used successfully for heterologous transplantation. The success of early attempts was recorded in the paper just mentioned. However, in view of the obvious importance of heterologous transplantation to both biology and cancer research, a preliminary report of the successful growth of rabbit tumors in other species of animals through serial generations and of a human cancer in rabbits seemed desirable.

Two rabbit tumors, an adenocarcinoma of the uterus and an adenocarcinoma of the breast have been successfully transplanted into the eye of the guinea pig. The methods employed were described in detail in the paper referred to above.[4] Transplantations were always made under anesthesia. The uterine tumor was taken from the sixth rabbit generation and so far has been transplanted serially through three generations in the guinea pig. The breast tumor was transferred to the guinea pig after two generations in the rabbit and is now growing in the second guinea pig generation.

Growth of the tumor in the foreign species presented the same characteristics as in the natural host. Microscopic examination of heterologous transplants show that so far the histological character of the tumors has remained unchanged. The cells of the transplant are descendants of the original neoplasm and not derivatives of the guinea pig.

The ultimate fate of the heteroplastic tumors is uncertain. At the present time, progressive growth has been observed in guinea pigs bearing the breast tumor for more than one hundred days and in pigs with transplants from the uterine tumor for as long as three months. So far, the tumors have not metastasized, but in no instance have the pigs been held for a period of time as long as that required for the development of metastases from homologous transplants.

A successful transplantation of a human scirrhus cancer of the breast has also been made, and slow but progressive growth has continued for more than eighty days.[5] In this instance, the transplantations were made during the summer months at a time when only a small percentage of homologous grafts are successful and growth rates are much reduced. Moreover, two hours elapsed between biopsy and transplantation of the tissue.

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[1] J. B. Murphy, *Jour. Exper. Med.*, 17: 482, 1913.

[2] Y. Shirai, *Japan. Med. World*, 1: 14, 1921.

[3] J. Putnocky, *Ztschr. für Krebsforsch.*, 32: 520, 1930.

[4] H. S. N. Greene and J. A. Saxton, Jr., *Jour. Exper. Med.*, 67: 691, 1938.

[5] This tumor was obtained through the kindness of Dr. R. A. Moore and Dr. W. A. Cooper, of the Cornell University Medical College.

Despite these conditions, the human tumor has grown in seven of the twelve rabbits used. Growth first became apparent toward the end of the third week when the rough edges of the fragments became rounded and their color changed to a pinkish-yellow in contrast to the dull white of pieces that failed to grow. The extension of blood vessels from the iris into the transplant occurred in four of the animals between the thirty-fifth and fortieth days. Vascularization has not occurred to date in three of the animals in which primary growth was observed, but notwithstanding the fragments have continued to increase in size.

The growth rate increased following vascularization, and at the present time the transplants are approximately five times their original size. In two instances the pieces are attached to the cornea, which has apparently been invaded by tumor cells and extension to the outside is imminent. In the remaining instances, the transplants are attached to the iris, and irregular projections of growth may be observed in many planes.

In so far as heterologous transplantation from rabbit to guinea pig is concerned, it has been definitely established that the anterior chamber of the eye affords a means of transplantation of the tissues of one species into the body of another where apparently they may be continued indefinitely. The human cancer has not been carried as far, but since the behavior of the grafts conforms in all respects with those of rabbit tumors in guinea pigs, it seems highly probable that human tissues can also be maintained indefinitely in the foreign host.

The serial transplantation and growth of the tissues of a mature animal of one species in an animal of another species opens up a number of interesting problems. Among them is the question of the specific nature of the tissue ultimately grown in the foreign host. This and other problems are under investigation. Detailed results of this series of experiments will be reported elsewhere.

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REDUCED BLOOD COAGULATION TIME BY INJECTION OF STEROL EXTRACT OF LIVER

DURING a study of sterols extracted from the liver, a more rapid clotting of the blood was noticed after one of the lipid fractions was injected subcutaneously into a hypophysectomized-depancreatized dog. A preliminary investigation therefore has been made of the effect of this fraction in reducing the clotting time in animals with a hemorrhagic tendency from ligation of the bile duct and from a vitamin K deficiency. Dam[1] and Almquist and Stockstad[2] have described the production of a generalized hemorrhagic tendency in chicks fed a diet deficient in vitamin K and were able to prevent the bleeding tendency by the feeding or injection of extracts derived from alfalfa, hog liver fat, green vegetables and other sources. The reduced prothrombin of rats after bile duct ligation has been elevated by feeding vitamin K, in large amounts or with the addition of bile.[3] Highly potent concentrates of vitamin K which can be injected parenterally have been obtained by Almquist[4] and by Dam and Glavind.[5] They describe the vitamin as a non-sterol, unsaponifiable lipid. Osterberg[6] also described it as a non-sterol, which was alkalilabile and fairly heat-stable.

The substance we employed in this study is a sterol which is fairly stable to alkali and heat. It has been obtained from the livers of dog, lamb and pig by the following method of extraction. One kilogram of ground liver from a freshly slaughtered animal was extracted at 50° C. with 2 liters of 95 per cent. alcohol, which was acidified with 0.3 cc of concentrated HCl, and then re-extracted with 2 liters of 95 per cent. alcohol. The combined filtrates were saponified for 18 hours at 45° C with 50 grams of $Ba(OH)_2$ and 80 grams of NaOH, then held at 0° C for 4 hours before filtering at room temperature. After concentrating the clear dark amber solution to ½ volume with reduced pressure at 40° C it was vigorously shaken with 500 cc of petroleum ether, the alcohol phase was diluted with an equal volume of water and shaken again. Two additional extractions were made with 200 cc portions of petroleum ether. Evaporation of the ether from the combined extracts left about 700 mg of a yellow crystalline material, soluble in about 10 cc of sesame oil at 38° C. Small amounts of this impure material gave a positive Salkowski and Lieberman Burchard reaction but negative Rosenheim and Pettenkoffer tests. Only a few milligrams of precipitate could be obtained by digitonin treatment of 500 mgm of the crude material.

The sterol fractions have been taken up in sesame oil for subcutaneous injection into normal and jaundiced rats and into vitamin K deficient chicks. Dogs have been used for the intravenous injections of the extract, suspended in an emulsion with lecithin in normal saline. For the determination of clotting time blood was drawn in the rat by syringe from the heart or from the femoral vein under light ether anesthesia, in the chick directly from a wing vein into a fine glass capillary tube and in the dog by cardiac or venous puncture. Coagulation time was determined by breaking the capillary tube and confirmed with a drop of blood on a glass plate. Determinations were made on individual animals before injection and at 6 and 24 hours afterward, then daily for several days.

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[1] H. Dam, *Nature*, 133: 909, 1934.

[2] H. J. Almquist and E. L. R. Stockstad, *Jour. Biol. Chem.*, 111: 105, 1935.

[3] J. D. Greaves and C. L. A. Schmidt, *Proc. Soc. Exp. Biol. and Med.*, 37: 43, 1937.

[4] H. J. Almquist, *Jour. Biol. Chem.*, 120: 635, 1937.

[5] H. Dam and J. Glavind, *The Lancet*, 1: 707, March 26, 1937; H. Dam, J. Glavind, L. Lewis and E. Tage-Hansen, *Skand. Arch. Physiol.*, 79: 121, 1938.

[6] A. E. Osterberg, *Proc. Staff Meet., Mayo Clinic*, 13: 72, 1938.

Five to 7 days after bile duct ligation the average clotting time in 30 old male rats weighing 300 grams or more was elevated to 10 minutes. Young male rats weighing 100 to 200 gms did not develop this hemorrhagic deficiency to the same extent, the average clotting time in 30 animals being only 3 minutes in from 6 to 12 days after the operation. Average results after injection of 60 and 70 mgm of the crude sterol extract and 15 mgm of the fraction which was not precipitated by digitonin are shown in the table. Reduction of the clotting time to a normal level occurred within 6 hours and persisted for 24 to 48 hours. Pure cholesterol and cholesterol recrystalized after digitonin precipitation exerted little if any effect as compared to the sesame oil controls. In smaller amounts, 14 to 20 mgms, the crude extract was less effective. Female rats were found to develop the hemorrhagic tendency after bile duct ligation more slowly than the males, showing an average clotting time of 3½ minutes in 6 to 8 days postoperative and 9 minutes in 14 to 22 days. Their response to injection of the various extracts was essentially negative.

TABLE 1

Effect of Injected Liver Extracts on the Blood Clotting Time (in minutes) of Jaundiced Rats and Vitamin K Deficient Chicks

Material injected	Mgm injected	Subject	No. averaged	Hours after injection 0	6	24
Pig liver extr.	60	Old rat	5	7	2	3
Non-dig. ppt. fract. .	15	" "	2	6	2.5	
Cholesterol	10–25	" "	3	13	8	12
Pig liver extr.	70	Young rat	4	4	2.3	3
Cholesterol	25	" "	3	2.7	2.6	3
Lamb liver extr.	20	Chick	8	20	8	3.5
Pig liver extr.	24–60	"	6	14	5	4
Non-dig. ppt. fract. .	15	"	5	15	8	5
Dig. ppt. fract.		"	2	14	3	6
Cholesterol	25	"	8	7	6	4

Subcutaneous injection also was effective in chicks on a vitamin K deficient diet. The average clotting time was 17 minutes for 36 chicks when 14 to 18 days old. After injection of 20 to 60 mgm of the active extract or 15 mgm of the non-digitonin precipitable fraction this was markedly reduced within 6 hours and was decreased further at 24 hours. The effect persisted for several days in some chicks, in others the clotting time increased again after the third day. The small amount of material precipitated by digitonin treatment was very active when tried in 2 chicks, whereas pure cholesterol in 25 mgm doses caused only a slight diminution in the clotting time. We are indebted to Dr. Robert Moore, of the Department of Pathology, for determining that the average prothrombin time was lowered from 10 min. in the controls to 3 min. in the chicks injected with the liver extract.

Normal male rats in a few experiments showed about a 50 per cent. fall in clotting time after administering 15 mgm of the crude extract subcutaneously. In three female dogs, one of which was jaundiced from bile duct ligation, a single intravenous injection of 10 or 15 mgm in lecithin emulsion produced a similar reaction. The clotting time remained at this low level for 48 hours and then gradually increased again. The effect of the intravenous injection was not directly on the blood, since the addition of the extract to freshly drawn dog blood *in vitro* tended to prolong rather than to reduce the coagulation time.

These results indicate that the liver contains a sterol which is active in reducing the blood clotting time of normal and jaundiced dogs and rats. A single intravenous or subcutaneous injection maintains this effect for several days. The extract is similar in action to vitamin K in that it will correct the hemorrhagic tendency in vitamin K deficient chicks when injected subcutaneously. Its sterol nature and resistance to alkali differ from the properties described for vitamin K.[7]

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THE BLOOD VESSELS IN THE CENTRAL NERVOUS SYSTEM OF THE KANGAROO

Wislocki and Campbell[1] have recently demonstrated that in the opossum the tissue of the central nervous system is not vascularized by a continuous spongy reticulum of capillaries such as exists in the brains of other mammals, so far as known. Instead, it is supplied by vessels which run in very closely associated pairs, arterial and venous, each member of the pair branching when the other does, and the branches ending as simple loops without any anastomosis. Such an arrangement had formerly been known only in certain lizards (Schöbl[2] and Sterzi[3]) and, in much simpler form, in tailed amphibians (Schöbl,[4] Sterzi[3] and Craigie).[5]

The phylogenetic relationship of the non-anastomosing capillary loops and the freely anastomosing capillary network is a problem of much interest, and the discovery of Wislocki and Campbell at once raises the question whether or not the condition in the opossum is one characteristic of marsupials in general and of monotremes. It is to be hoped that the matter will soon be investigated where such animals are freely available.

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[7] See references 4, 5 and 6.

[1] G. B. Wislocki and A. C. P. Campbell, *Anat. Rec.*, 67: 177–191, 1937.

[2] J. Schöbl, *Arch. f. mikr. Anat.*, 15: 60–64, 1878.

[3] G. Sterzi, *Anat. Hefte*, I Abt., 24: 1–364, 1904.

[4] J. Schöbl, *Arch. f. mikr. Anat.*, 20: 87–92, 1882.

[5] E. Horne Craigie, *Proc. Amer. Phil. Soc.*, 78: 615–649, 1938.

Meanwhile it has been possible to examine sections of the cerebellar cortex and of the cervical region of the spinal cord of a specimen of *Macropus bennetti.* The specimen had been in formalin for some years, so that injection methods were not applicable, but a variety of stains were tried, of which that of Perdrau yielded the most useful, though not very good, preparations. These show clearly that the disposition of the vessels in the tissues examined is largely, and probably entirely, the same as that in the opossum. The vessels run in closely associated pairs, the one member usually noticeably larger than the other. Each member of a pair branches when the other does. The branches end in simple loops and there is no evidence of anastomosis. Thus it appears probable that the central nervous system of the kangaroo is like that of the opossum in being vascularized entirely by much branched, but strictly non-anastomosing, looped blood vessels. The fact that the two marsupials examined, representing different superfamilies and different geographical areas, both show this character suggests the likelihood that it is a feature of the Metatheria in general.

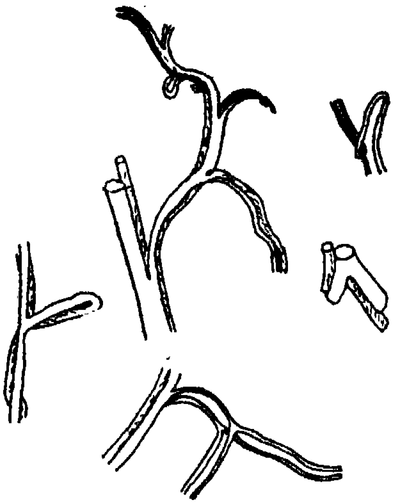

FIG. 1. Drawings of vessels in a section 150 micra thick of the spinal cord of *Macropus bennetti,* stained by the method of Perdrau.

Scharrer[6] has emphasized the end-arterial character of the arteries entering the brain-substance of the opossum, but has pointed out that the branches of adjacent pairs of vessels interlace in such a fashion that any given mass of tissue is supplied by branches from several of them. The close association between the two members of a pair throughout their length does not appear to have been discussed, however. Mossman[7] has shown that in the placenta of the rabbit the maternal and foetal vessels run parallel to each other in opposite directions, so that as fetal blood runs through the placental capillaries it comes into association with maternal blood of increasing purity and may be in approximate equilibrium with the arterial blood of the mother when it reaches the umbilical vein. It seems possible that a somewhat analogous situation exists in the central nervous system which is vascularized by capillary loops. A spongy reticulum permits a more or less free distribution of blood in all directions through the tissues, but when the supply is entirely by closed, non-anastomosing loops, the venous limb of each loop would tend to carry less oxygen and nutriment and more waste products than the arterial limb. If the limbs were spread widely apart, the tissue immediately surrounding each venous limb would thus be supplied with blood poorer than that supplying the tissue surrounding each arterial limb. The two limbs being so closely associated as they are, however, the blood flowing along the venous limb and tending to decrease in purity is associated with blood of increasingly arterial character in the arterial limb. Thus a relatively uniform condition of the blood throughout the capillary loop may be maintained and every part of the tissue through which the loop passes is more likely to have an adequate supply. Such an arrangement would be of obvious value in the salamander brain, where the loops are simple and there is no extensive interlacing of branches, and would doubtless be equally important in the nervous system of the warm-blooded animal, with its greater metabolic requirements.

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BOOKS RECEIVED

- BRADLEY, JOHN H. *Patterns of Survival; An Anatomy of Life.* Pp. 223. Macmillan. $2.25.
- CAYLEY, NEVILLE W. *Australian Parrots; Their Habits in the Field and Aviary.* Pp. xxviii + 332. Illustrated. Angus and Robertson, Sydney, Australia. 12/6.
- HAGGARD, HOWARD W. *The Science of Health and Disease; A Textbook of Physiology and Hygiene.* Pp. xiii + 594. 10 plates. 89 figures. Harper. $3.00.
- MILLIKAN, ROBERT A., HENRY G. GALE and CHARLES W. EDWARDS. *A Manual of Experiments; To Accompany "A First Course in Physics for Colleges."* Revised edition. Pp. v + 221. 134 figures. Ginn. $1.10.
- MOON, TRUMAN J. and PAUL B. MANN. *Biology; A Revision of "Biology for Beginners."* Pp. x + 866 + c. 405 figures. Holt. $2.00.
- TIFFANY, LEWIS H. *Algae; The Grass of Many Waters.* Pp. xiii + 171. 41 plates. 12 figures. Charles C Thomas. $3.50.

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[6] E. Scharrer, *Zeits. f. d. ges. Neurol. u. Psychiatrie,* 162: 401–410, 1938.

[7] H. W. Mossman, *Am. Jour. Anat.,* 37: 433–497, 1926.

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THE ROLE OF PURE SCIENCE[1]

By Dr. RALPH W. GERARD

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ONE anecdote has it that, when Gladstone, shown the electromagnetic motor, asked, "What good is it?" Faraday replied, "What good is a baby?" The same question might be asked about science itself, the last great offspring of civilization, sired by intelligence. If no longer a baby, it is at least an obstreperous child, already playing mischievous pranks on its staid mother, and fearsomely regarded by many as irrevocably headed towards a wayward youth and a criminal maturity. Some babies are best unborn; is this such a one? Science, we hear, has warmed our homes but not our hearts, increased our longevity but not our charity, raised our speed but not our hopes, brightened our nights but not our spirit; in short, that it has comforted our flesh but destroyed our soul. Society is sick and science must be poisoning it, for it has been taking great mouthfuls of the bitter stuff; and is it not always something just eaten that is responsible for any ache?

As a physician, I know that a generous portion of peppermint, applied outside or in, neither brings on nor wards off a renal colic; and as a scientist I demand better evidence than "post hoc ergo propter hoc," before agreeing that the social organism is suffering from scientific dyspepsia. But let us clearly understand one another before proceeding.

"Science," as Conklin, retiring president of the American Association for the Advancement of Science, said last week, "is organized knowledge, and knowledge itself is neither good nor bad but only true or false." Pure science is concerned only with understanding, not with using; it might be denounced as valueless, never as harmful. But, comes the cry, this is sophistry; for are not scientists incessantly prating their wares and asking society [illegible] buy of them; do they not ask to have their researches subsidized and promise a *manifold* return on the investment; is there any demarcation between pure science and applied technology, which most assuredly does use knowledge for weal or woe. Let me answer in reverse sequence.

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[1] An address presented before the American Institute at a symposium on "Some Social Implications of Inventions."

Pure science is not distinguished from applied by method, which is identical for both; often not by content, which may overlap in each; but by intent alone. The technologist endeavors to solve a problem with a view to immediate utilization—whether for individual or general ends; the scientist, only to know the solution. His immediate gain is the selfish satisfaction of the climber struggling to the summit, of the poet rounding his rhyme or, if you will, of the successful cross-word puzzler. Hill, a Nobel laureate, has put it well.

> In scientific research we work and work, sometimes for months and years, in digging a tunnel with no apparent results; then suddenly comes the supreme joy of life—daylight begins to glimmer at the end, and in a few minutes we see that nature, after all, has not played us false. To one who works honestly and accurately, these moments are sure to come.
>
> It is no use, therefore, to tell a scientist that romance is dead, or a physiologist that physiologic problems are insoluble; the emotions he has experienced in finding new worlds will effectively prevent him from believing you. No joy can be greater than to find convincing evidence for one's faith that nature is ultimately reasonable, no emotion more satisfying than to achieve exact and quantitative verification after months of trial and experiment. Do not think, therefore, that the new laboratories here are peopled with patient drudges, moved perhaps by intelligence but never by emotion. There may be as much real poetry, as much real magic, as much real romance, within these walls as a human life can hold.

Or, again, there is the story of the three hod carriers. On being asked, "What are you doing?" the first replied, "Carrying bricks"; the second, "Earning a dollar an hour"; the third, "Building a cathedral." The last represents pure science.

True, few scientists would justify their labors on such a basis, even to themselves, let alone to society. That may be the reason they wish to do research, not the one that makes them think they should do it, and be aided in the doing. There is, besides, the conviction that the fruits of discovery will benefit all mankind—not at once but soon or late, and riper and more luscious for the waiting. They point out to themselves and the world, correctly, case upon case of the "purest" scientific advances that have risen rocket-like into the intellectual sky only to burst and scatter mankind with riches; induced electricity and the motor, electrons and radio or what you will, hormones and the relief of disease, structural formulae and modern creative chemistry. But, then, pure science is simply long-range application; and motors and radios do make noise, and chemistry creates explosives and tough steel from which to shoot them, and science is daubed with the same paint as technology.

From my view-point, science has another far more valuable contribution to make to mankind than that of upholstering his physical comfort; a vital contribution to his mental climate. And this is at least tacitly recognized by modern educators who include ever more scientific subjects in the curricula. Surely none is so fatuous as to believe that a few semesters of dabbling in physics, chemistry and biology at the high school or college level will prepare the student to build or even repair their autos and radios, let alone to improve upon them. It takes no great erudition to be a handy man about the house, and radio repair men do quite well without having heard of the Schott effect or the uncertainty principle. In biology, where the gulf between common experience and the more esoteric expert knowledge has not yet opened so widely, some practical returns may result from even a casual acquaintance with the latter. It may be useful to know, for example, that spinach is not especially rich in iron, that cathartics do more harm than good, that yeast has no magic dietary virtues, and that patent medicines are, almost without exception, expensive packages of common chemicals and more often harmful than efficacious. But we don't ask the precious hours of youth just to warn them to polish the arsenic spray from their apples before eating them.

Education has two major aspects: utilitarian, vocational training to enable one to live effectively in society, to do; and esthetic, avocational training to enable one to live with himself, to be. The former includes the pre-school shaping into the major molds of civilized behavior, with the aid of the few "do's" and the many "don'ts"; the use of language and number taught in elementary school; and such technical information and skill as are acquired in appropriate trade or professional schools. It is reasonably tangible, and on the whole this education achieves its goal. The esthetic education—the word is not satisfactory for it should embrace more; yet I would prefer it to ethical and so emphasize beauty over good; better is the Greek, Kalos, which includes the good, the true and the beautiful—the esthetic education is the general education which President Hutchins, of the University of Chicago, has recently expounded. It is the appropriate nucleus of high school and college, although not university, training; the very portion of the curriculum which is being enriched with science courses.

This phase of education is confused because its ends are so intangible and the progress towards them so difficult to evaluate. But it is incomparably more important than vocational training, for it shapes the man and so eventually the society. I hasten to add that esthetic education is not purveyed only in college classrooms at so much a course—it is acquired by steady accretion from family and other social groups. But any formal inculcation of its elements is concentrated at this level, and only by this means can conscious and deliberate direction be given. What, then, should this training for self include?

I submit that it must deal with values and with judgment, must help to establish individual standards and to display materials of worth. Let me be more specific. An ear tuned solely to such strident rhythms as "Yankee Doodle" will not at once respond to Beethoven's softer cadences, melodic though they be; nor will the magnificent panorama of celestial and animate evolution have any appeal to the intelligence that has never soared from a bookkeeper's desk. Certain intellectual and emotional events have value to persons able to appreciate them, and bring additional pleasure and richness into their lives. Man is the highest animal only in the sense that he has the possibility of a greater variety of experience than have others, and the "higher" type of man can savor adventures of the spirit to which the lesser one is insensate. In this sense, then, one may speak of establishing standards of and a taste for the worthy and good—a task of esthetic education.

Besides implanting an urge for the good, the true and the beautiful, this phase of education should offer examples of them and, even more, acquaint the student with their sources in library, laboratory and museum, and encourage him to explore them. Facts and ideas, no less than poems and pictures, may have their beauty. I shall never forget the state of exaltation in which I left the chemistry lecture room after hearing, in the even slightly monotonous voice of Julius Stieglitz, the story of the brilliant logic and inspired experimentation with which Emil Fischer built and identified the unknown but theoretically anticipated kinds of sugar molecules. To one without the requisite background, the lecture would be a tedious mistake. The painter finds much in a picture overlooked by others, the chessplayer alone can rhapsodize over a scholarly mate, the scientist can see in the starry sky or the human body beauties invisible even to the lover's eyes. Science, like art, contains the beautiful and offers ever more riches to him who penetrates its terrain from the frontier of dilettante interest to the hinterland of research advance.

The avocational part of education must include, besides the esthetic, still other elements which are of no less importance to the individual and of the gravest import to society. These have to do with truth and judgment, are primarily at the intellectual level, and are quite particularly related to science. To the extent that man acts rationally, he makes progress in the battle with chaos, and he and his society become more integrated and more complex. Irrational behavior, directed by emotion when intelligence is uninformed or in abeyance, is sooner or later retrogressive. This dichotomy of intelligence and emotion, as we shall see later, is rooted in very well-known brain mechanisms.

What are some earmarks of intelligent behavior? First, the absence of superstition, the emancipation from fear of nature and the here-and-now prejudices of the group. I doubt if we of this century and culture can remotely glimpse the load of fear and darkness that oppressed less enlightened souls. Think of the aboriginal gods—lurking in animals and trees, in earth, winds and waters; cruel, demanding, all-powerful; quick to destroy, difficult to propitiate; rendering the future insecure and the present restricted—that peopled the primitive imagination. Recall the native, taught by missionaries to plow deep, who, alone in his tribe, grew grain despite a drought and whose torn-off limbs were scattered on the field to repel the Evil One. Think of our own recent history—the heretics tortured, the were-wolves burned and witches drowned, the sick exorcised; largely in good faith. The Koran was only recently printed in Islam, for it was blasphemy to touch the word "Allah" with pig bristles. Think even of the shrouded nether-limbs of a past generation and the stilted forms of ordinary communication. Our present intellectual climate leaves much to be desired. Heaven knows we do not yet walk in the light of clear day, yet we can look back at the pea-soup fogs of the past with some sense of progress. This I credit to science.

Second, intelligent behavior is marked by tolerance. The new is neither fatuously accepted nor blindly damned. Decisions are reached after due instruction in and evaluation of the facts, pro and con; and action, while not always correct, is rational in the light of the evidence and, since action generates new evidence, it is automatically self-corrective. Need I belabor the past on this point, too, and recall to you the ignoring or persecution of nearly all great innovators of history? Possibly a single instance will be interesting. I quote from the "Report on Technological Trends and National Policy": "In Germany, it was proven by experts that if trains went at the frightful speed of 15 miles an hour on the proposed Rothschild railroads, blood would spurt from the travelers' noses, mouths, and ears, and also that the passengers would suffocate going through tunnels." This, of course, is a mild example and seemingly based on facts and reason, yet a real effort to evaluate, as quantitatively as possible, is conspicuously lacking. As Boake Carter has said, Everyman is the worst censor. Let a radio speaker discuss a live issue, and proponents of one or both sides flood the sponsor with threats. I contrast the attitude of William Jennings Bryan, who said to an eminent botanist, "I know nothing of evolution but hate it with my whole heart," with that of Thomas Huxley, shown in his famous invocation, "God, give me the courage to face a fact though it slay me." Intellectual honesty is the motif of science.

Third, intelligent behavior does not confuse the symbol with the thing. This requires some explanation. Man tries to understand nature, for his pleasure and profit. But nature is a blooming buzzing confusion of semi-discrete units and systems in a great continuity. Analysis can not proceed until this is ordered into classes—for logic and science deal with the constancies of the category and not with the uniquenesses of the individual. This organization and attendant distortion of "reality" (and let us not enter the metaphysical problem as to whether a real universe exists) is carried out in part by the physiological processes of sensing, in part by the psychological ones of reasoning. Only after grouping individuals into classes can logic proceed, yet any such classification violates the individuality of the members of the class. "Nature," as Whitehead says, "doesn't come as clean as you can think it." Yet, "thought is abstract and," he continues, "the intolerant use of abstractions, is the major vice of the intellect." Words, themselves, are classes and stand only as symbols for something else, symbols which are imperfect and shifting representations of that for which they stand. Their meanings change— as, for example, in the adage, "The exception proves the rule"; "proves" to-day has the meaning "demonstrates," although originally (and with greater wisdom) it stood for "tests" and is still so used in "proving ground." "Facts" also are abstractions and, like words, may lead via the machinery of the most impeccable logic to bizarre conclusions. Even philosophers have fallen into the "error of misplaced concreteness"; most of mankind wallows in it. Label a man or an action bolshevist or fascist and he or it is damned; make the eagle scream out for Americanism and it, with all the lice that inhabit it, is welcomed into our homes. The antidote is science.

I have said that education for truth, for a rational behavior, engenders freedom from superstition and prejudice, inculcates tolerance and the open mind, and brings discrimination of the symbol from the symbolized. I credit science, pure science, with such progress as civilization has made in this direction and maintain that in its charge lies further advance. On what grounds is so much claimed for science? Conklin has summed the case up admirably, ". . . as an educational discipline there are no other studies (than science) that distinguish so sharply truth from error, evidence from opinion, reason for emotion; none that teach a greater reverence for truth nor inspire more laborious and persistent search for it. Great is philosophy, for it is the synthesis of all knowledge, but if it is true philosophy it must be built upon science, which is tested knowledge."

Science is tested and organized knowledge, gleaned and tried with the aid of its powerful method. Surely it is not necessary before this group to reiterate the character of this process—observation, explanation, experimentation and rejection, or, occasionally, confirmation. The elimination of chance by repetition, of extraneous factors by controls and of faulty conclusions by tests of their predictions are commonplaces to you. This habit of mind and action is indigenous in but not confined to the laboratory. It is the flowing river that deposits a rich alluvial delta of new-made wisdom. It is the greatest invention of man, the method of invention.

If our sacred cows of belief and convention can not stand the light of reason they are sickly animals. Do you maintain that science has undermined the foundations of ethics, I reply, "Only of false ethics." There is no conflict between the true and the good any more than between the true and the beautiful. Whichever idols have crumbled with the growth of science were made of clay, and it is well to have cleaned out the debris. Religion is struggling to establish new ethical values; surely science, which has faith in truth and honesty, in patience and order, strains at her side. Perhaps, even, the new ethics will stem from science directly.

On the other counts, tolerance and realism, the case for science, for its method, is unequivocal. Both depend on reason tempered by facts, on logic checked by empiricism at each extrapolation, on drawing honest conclusions. He who would navigate onwards into the unknown must steer on the star of truth with the compass of logic, but he dare not neglect to take frequent bearings with the sextant of observation. And this is the way of science. Pure science has these great contributions to make to society, through general education, a tried methodology and disciplined minds with which to attack its problems.

Many of you, I am certain, are now about at the bursting point of indignation with my elegiac mood. "Man, alive," you would say, "stop talking like an evangelical Pollyanna and look at some facts yourself. Science has been taught in increasing intensity for a century or two and you have already admitted that we still are clouded in prejudice, intolerant to an extreme degree, and regularly misled by words. And you can't wriggle out of it by saying that science has not adequately reached the masses, for we know any number of scientists who are as egregious asses as the rest of us when they dare to emerge from their narrow specialties, which, by the way, they rarely do."

Yes, I know. Much that passes for science is utterly trivial and many of its supposed devotees are dull followers of a trade. Don't you, my friendly challenger, make another error and mistake the word for the thing. If you define "science" as the produce of departments of physics, geology, botany, etc., and "scientists" as the men who people them, we are not talking quite the same language. One must distinguish religion from creed, religious experience from formal worship, creative painters from rote copyists, brilliant explorers from the gleaners that trail them, intellectual calisthenics from a mental Turkish bath.

Yet I must admit there is something to your position. Scientists to-day fall far short, on the average, of what one might expect from them. It is, perhaps, possible to trace the reasons. A century and more ago, science was an esoteric pursuit. The men who followed its call were amateurs, usually wealthy or patronized. They worked largely as individuals at an avocation or hobby, like philatelists to-day, because they enjoyed it. They were eddies in the social stream, amusing or ludicrous to the serious-minded of the time but not important. One cultivated science as one cultivates a garden, without ulterior motive beyond the satisfaction of watching its lovely flowers unfold. Not so to-day. Science became useful, its flowers yielded expensive perfumes and healing drugs, and it was taken up by the best society. Departments of science crowded into and multiplied within universities, even high schools; research institutes sprang up; industry sprouted laboratories or subsidized technical schools and plants; great foundations pumped nourishment into all these, aided here and there by government. Technology spread everywhere, new industries based upon it grew into gigantic stature. And men were needed.

The little band of scholars quietly exploring intriguing corners of the unknown was lost in the surge of recruits. Science had become a respectable profession and, if not promising quite the financial success of the older ones, it had other desiderata, as security. Students rushed to grasp the new opportunities and were welcomed into the schools and later into the industries. Some became the teachers for later groups. The main orientation was utilitarian, the motives, economic, the caliber, small. Democracy triumphed and the intellectual aristocracy was dead.

But if this were the whole story, my case would be barren, indeed, with real science necessarily the prerogative of the elite alone. A more fundamental problem exists than the mere expansion of science due to social usefulness. This, in itself, is probably to be applauded; certainly there is no more cause for dismay than is offered by the existence of a medical profession. The trouble is with education as a whole. It is too much a Turkish bath.

I have described earlier what education should be and the pivotal position in it of the scientific attitude. But, although courses in chemistry and physiology flourish everywhere, few students are ever given a glimpse of science. They learn the facts, theories and techniques of a subject, yes, even how to plan and evaluate experiments, but they rarely are exposed to the true scientific spirit. How could they be when the men who teach them do not have it? Some years ago I heard a student who was just about to receive his Ph.D.—mind you, his degree as doctor of philosophy—tell in a seminar about the French "anatomist," Descartes. The name was obviously new to him, he pronounced all the consonants and misplaced one—Descrates. He is now teaching science to another generation.

There is a cycle in education which might be benign but is still vicious. Bad teachers teach students badly so that they in turn become bad teachers. Ignorance, like syphilis, would be eliminated if we could only make it spare one generation. What a stride forward humanity would take if just one crop of youngsters was put through the hands of really good teachers! This is just pleasant day-dreaming; we have not enough good teachers nor prompt means of developing them. Yet the situation is not hopeless, and civilization has always had to pull itself up by its bootstraps. Leaders do emerge, talent does exist, and barbaric hordes do become cultured. Real scientists and teachers are among us in considerable number, and when society is prepared to encourage and support them, and recruit to their ranks other men of ability, progress will be rapid; for, as I have shown elsewhere, the scientific spirit *can* be imparted to students.

There is one more point to make about teaching scientists and educators in general, especially in this country. Let me say it quickly and have it over, for it is rather shameful. The truth is that those in social and financial power—donors, governments, founders—have so little confidence in professors that they do not trust them to run themselves, let alone others. Almost without exception, a separate body—of trustees, president, deans and other administrative officers—runs our universities and the faculty pretty much does what it is told. Administration is often enough excellent, and academic freedom is jealously guarded in any university worthy of the name, but the fact remains that our institutions of higher learning are painfully different from a republic of scholars.

Is it any wonder, then, that science has made no greater impress on the mind of man and that scientists are so often found wanting? They have nearly all been taught badly, except in some limited field of proficiency; they have been debased by the rapid and incompletely assimilated influx of opportunists; they are little prized, except for their technical skill; of course they are oblivious to or prejudiced about most problems of society. A man may do sound scientific research yet not exhibit generally the scientific attitude nor impart it to his students. But one who has not even this apprenticeship to truth is likely to do less well.

Let us return to our sick society, for something surely ails it, although I hope to have shown it is not pure science. What medicine does it need, and who should administer it? The treatment depends on the diagnosis, of which more shortly; the scientist has often been put forward as the physician. Now I suspect that a really first-class scientist may make a first-class statesman—was not the chemist, Eliot, one of Harvard's greatest presidents?—but I doubt if he would be more likely to be so than other first-raters. The scientist has on his shoulders even now, besides his chosen task of research, the duties of teacher and often philosopher (as well as citizen and individual), and that of administrator is not lightly to be assumed. Further the innovator is rarely the developer; not Trotsky but Stalin directs the destiny of Russia. No one man has genius enough to run a nation, and it seems wiser to have in charge a skilled politician who relies on expert scientific advice than to have a skilled engineer advised by expert politicians. The important thing is that the best knowledge, the best brains and the best will be drafted to the task. This is not easy of achievement; but more later.

Now, what ails society and puts the time out of joint? Is it technological advance as such or the discrepancy between this and static institutions or something else entirely? Two accusations are made against technology—it has made war horrible and peace ugly and impoverished. As to the former, gunpowder is only powerful—not good or bad. If used for ill, the fault is with the user. Poor old human nature must take the blame. And although it is true enough that it is better to keep powerful weapons from irresponsible hands, the only realistic solution here is to eliminate the irresponsible for, willy-nilly, technology will march on.

The influence of technology on our work-a-day society requires further comment. Ogburn, in the report of the committee already referred to, points out the sequence of changes following a new and important invention. First there is a lag (a third of a century or better) before it is accepted and applied; then comes its technical use and the attendant economic changes; later, often much later, there follows a modification in social institutions—home, church, government; and only at long last do the customs and beliefs of the populace fall in line. The spinning jenny is blamed for the industrial age. Yet it was merely a more efficient instrument for getting work done, just as the electric vacuum cleaner is more efficient than the broom. Have you ever heard the myriad household aids blamed for social dislocations—the electric washer and iron and mixer and cleaner and stove and razor and light? Oh, yes, we grumble about the lady of the house wasting her time on bridge and her money on beautification now that the galloping watts leave her skin soft and her hands potentially idle, but we love her all the more.

Had the new tools of industry likewise remained in the hands of the single worker in his house or shop man, like woman, would have been the gainer. But, of course, they were too large for the individual home and purse of the worker and note, please, for the purse of the inventor as well. So they passed into the hands of the entrepreneur and banker who, in full harmony with the current mores, exploited them to the limit for their personal gain. There resulted more goods and profit from less work, but the owner took the profit and the worker lost the work. Less skill was required, so women and children were hired instead of men and more cheaply. There followed in course the decay of the family and the rise of the slum. Later, much later, the social ethics stirred in its sleep and folk began to look askance at the robber barons of a new age of feudalism.

So far you must all agree, these evils following invention (the accelerated tempo of life in general is a separate question) did not flow from the technical discovery but from its befuddlement with property rights which took precedence over human rights. To-day the mass of the people repudiate such standards and many nations have expressed a collective discontent by plunging into great social ventures and new -isms. The world is groping in many directions for new air and light; all sorts of expedients are being tried, blunderingly; but the spirit of change is marching and can not be stopped.

I should be a poor scientist indeed, with my lack of knowledge and experience, to presume to know the proper answer. The diagnosis, I think, is fairly clear, but the disease is unfamiliar and the therapy to be worked out. But this much I must say, as a scientist. Here is an empirical problem requiring rational solution more urgently than any in human history—and the scientific method is the one best proven instrument for solving it. Even this may not succeed, but then no other attack will either and humanity will grind itself into decline.

It may be worth a final few minutes to examine more closely the possibilities. One of the most significant of technological advances is that of communication. The talking movie and the radio at present, to be supplemented at any moment by television and the home printed news sheet, afford amazing means for influencing the collective mind. Entering the home, reaching the child, they carry terrific power for leading the intelligence on by education or debasing it by propaganda. And remember human beliefs are social facts; for man's acts depend (in part) on what he thinks is true, aside from its objective truth or falsity. It will not do any longer to cleave to a laissez-faire principle, for it is being flagrantly violated. Once a dictator captures the people's mind by censoring the unpleasant and broadcasting the spurious they are indeed his slaves, for even reason is powerless with faulty materials. Something must be done, now, to secure for the ends of proper education these channels of influence.

But who shall control communication and make the all-important decisions as to what constitutes proper education? Is not human nature such that any man or any group wielding this enormous power will drift into selfish tyranny? Perhaps so; but this is certain, that there will be least abuse at the hands of men conditioned to intellectual honesty, tolerant judgment and respect for truth.

At least it would be a simple matter even yet to keep the control of technology, and so of social institutions, in the hands of scientists. Scientific discoveries of the past have, by and large, been given freely to the community; even the detailed applications have not often been patented. They have been exploited by others for private ends, sometimes in anti-social ways. As great industries of the present have arisen from past research, so surely those of the future are being born in the laboratories to-day. If individual scientists or, better, single universities or, better still, national scientific societies or, best of all, a distinguished body representing all science, and government as well—as the National Academy of Sciences or the National Research Council (to consider the national rather than the international level which must eventually supersede it) —were to patent future discoveries and control their development and their impact on society we would have a better world. Not perfect, ever, but improving, probably; and surely with a greater chance of success than when, as now, the implements of propaganda and control are allowed to fall into the most grasping and ruthless hands.

Scientists are more men of thought than action, they prefer to have the evidence, which is never all in. All agree that, to-day, by applying known or strongly surmised genetic laws to man the breed could be altered very considerably. But they are not certain what to breed for, have little control of the breeding, and fear the consequences of mistakes in the form of ill-begotten beings which may not be destroyed. All agree that, to-day, with a growing knowledge of educational aims and techniques, with a sound child psychology, the thoughts and even the more important motives that determine action could be modified. But they are not certain of what to educate for, have little control of mass education, and fear the consequences of mistakes in the form of neurotic misfits which may not be curbed. This attitude is sound—but only if time permits a proper evolution. This is not so; power multiplies and usurpers are reaching for it, dictatorship is in the air, events are rushing a decision. I believe that men of good-will must act; I would rather trust the destiny of civilization to even a second-rate group of scientists and educators than to the present type of dictator. They at least would aim for truth and profit by errors. Perhaps the world will owe Hitler a debt of gratitude, after all, for pointing the issue sharply enough to force better men to act.

A final word. The fate of our institutions and culture depends, when all is said, on the few who wield great power. Whether scientists, bankers or politicians, they remain still men. The great questions are: first, is the human intellect capable of solving, at any time in the future and with any amount of scientific analysis and even experiment, the labyrinthine problems of human relations; and, second, will not might forever make right, so that the selfish, ruthless and aggressive will arrogate control, however the game is played? The answers lie in the future, yet I shall be reckless and assume the role of prophet for the nonce.

Science is not able to deal with all nature. We have already seen that the individual as an individual is outside its province. The "private" lives of each of us may be penetrated by esthetic or religious or scientific experience but are not subject to scientific analysis. But the class, even the individual as an organization of simpler units, lies within its capacities; and social problems are no more insoluble than biological ones. Man's understanding and control of the body to-day are no less than they were of inanimate nature a century back. Living things are vastly more complex than non-living, just as social beings are more so than solitary ones. Each complexity as it is approached seems to resolve itself into many simpler problems and the mind has rolled over them. It is as gratuitous an assumption that man's intellect will be baffled at the level of social analysis as was the one that blood would spurt from his nose if he moved at the frightful speed of fifteen miles an hour. I see in question one no cause for pessimism.

The second is more uncertain in my mind. The human brain contains an old portion, the hypothalamus, essentially like that of all his vertebrate relatives, and a new portion, the cerebral cortex, most richly expanded in him alone. The old brain is concerned with the emotions, the new one with intelligence. Fear and rage he shares with all, judgment and foresight are almost uniquely his. It would probably be impossible, surely unwise, to eliminate the selfish elements of self-preservation from man's make-up; but it may be possible and is surely desirable to control and guide them. Knowledge is cumulative in time, generation building on generation, while emotion is not. Perhaps cerebral control is increasing. Modern psychiatry is finding the hidden springs of behavior and modifying their flow. Men will probably always want more than their share, but perhaps it will not always be of the same things. The mass desideratum now is money, yet large groups of men have completely renounced this end for another; for example, fame. As man learns more of himself, his neural mechanisms, the hormones that modify them, the drives they generate, and the personal and social consequences of his acts, much control will undoubtedly be possible. And this knowledge will be deposited only by the stream of science. I am perhaps not overly guileless in believing that reason will sufficiently dominate emotion to keep a functioning civilization from perishing. Some emotion is needed, but the future of society is a direct challenge to the cerebrum of man and to its tool for rational advance—pure science.

OBITUARY

ALBERT SHERMAN

DR. ALBERT SHERMAN, research associate and Stephen S. Wilder fellow of the Basic Science Research Laboratory at the University of Cincinnati, died suddenly on July 1, following a period of illness. He was a brilliant theoretical chemist and probably the leading authority on the practical application of activation energy calculations to chemical reaction rates. His death at the age of 31 is a handicap to the development of this new and important branch of chemical kinetics. He has written twenty articles in the field of mathematical chemistry published in several journals, but chiefly in the *Journal of Chemical Physics*.

Born and raised in San Francisco, Dr. Sherman was graduated from the chemistry department of the University of California and went to Princeton University, where he received the Ph.D. degree in 1933. Here he came under the stimulating influence of Professor Eyring and Professor Taylor, and in this period published several articles in the rapidly developing application of quantum mechanical calculations to chemical problems such as adsorption, and deuterium reactions. He received a National Research Council fellowship and went to the University of Wisconsin, where he remained as fellow and research associate with Professor Daniels until 1937, except for a second appointment to a National Research Council fellowship to study in England with Professor Lennard-Jones.

Of this period of his scientific work, three outstanding papers are typical—a long review article with Professor J. H. Van Vleck on the "Quantum Theory of Valence," an article on the "Addition of Halogens to the Double Bond" and an article with Moelwynn-Hughes on the various types of interaction between solvent and solute and their influence on reaction rates.

A year ago Dr. Sherman was appointed to an interesting position on the staff of the Basic Science Research Laboratory at the University of Cincinnati. He had the opportunity of giving advanced courses in quantum mechanics, valence and thermodynamics, directing research and cooperating with the industries around Cincinnati. At the Symposium on Recent Advances in Chemical Physics of the American Association for the Advancement of Science, Dr. Sherman gave a paper on the "Calculation of Activation Energies," and in a forthcoming book he has contributed a chapter on the "Theoretical Basis of Halogenation Reactions."

Not only in his publications has Dr. Sherman helped to advance chemistry but also in the help which he was constantly giving to other investigators. He was liked and respected by all the graduate students with whom he came in contact at Cincinnati, at Wisconsin and at Princeton. His advice was eagerly sought by many in getting the most possible out of a series of experimental measurements, and both in formal lectures and informal conferences he stimulated others to more mathematical and more valuable treatment of chemical problems.

Dr. Sherman is survived by his parents and a sister in San Francisco. He is survived by Dr. Jack Sherman, an identical twin brother, who is also a prominent mathematical chemist, located at the laboratory of the Universal Oil Products Company.

FARRINGTON DANIELS

ELLIS STANLEY JOSEPH

THE death of Ellis S. Joseph from a heart attack on September 16 ended the career of one of the world's foremost animal collectors. Mr. Joseph was 66 years old, and had been in virtual retirement for the past five years due to ill health.

Born in Bombay, India, of English parents, he was educated in an English school in Shanghai. His father, said to have been a wheat farmer and horse owner in India, wanted the son to become a doctor. But the lure of travel and adventure was too strong, and when only eighteen the young Joseph began making expeditions into the wild country in India, bringing back rare birds and animals. As he grew older, his horizons widened, and he was soon traveling into the most remote parts of Asia, Africa and Australia, selling his finds to zoos all over the world. Before the world war he established an animal farm near Sydney, Australia, which he used as his headquarters and clearing house. In 1923 he moved his headquarters to New York.

His quest for the rare and the difficult took him to almost every country in the world. He was one of the few collectors who obtained and cared for his specimens with his own hands. He consequently had remarkable success in securing the most unusual specimens and in delivering them to buyers in excellent condition. A complete enumeration of his almost superhuman achievements is impossible. Once, in Sierra Leone, an infant chimpanzee, about to die, was saved by persuading a native mother to nurse it for several weeks. On his first visit to New York in 1920, he brought a record-breaking shipment of camels and other animals, and in that same year delivered to the New York Zoological Park the first blue-birds of Paradise ever seen here. He also brought over the lungfish and the first Australian koala to be seen in this country.

On July 13, 1922, he delivered to the New York Zoo the first and only duckbill platypus ever held in captivity. The platypus lived only 49 days in New York, but the method used to transport the animal to this country still provides anecdotal material among animal collectors. For half a century the platypus, which thrived in a certain kind of watery habitat, had resisted all attempts to transplant it from Australia. After working five years on a scheme to duplicate the conditions under which the animal lives, Mr. Joseph devised the "platypusary"—a cage containing a system of water tanks through which the animal swam to a dry burrow. As the platypus ascended from the water into the sand it passed through a series of rubber gaskets which squeezed the surplus water off its body.

Mr. Joseph was so reticent and shy of publicity that much of the story of his life was never told. On several occasions, when besieged by newspaper men or by publishers desiring him to recount his adventures in book form, he refused; and it was to only a few intimate friends that he would occasionally describe his experiences in the bush.

His physical appearance was arresting. A huge figure of a man, more than six feet tall and weighing nearly 300 pounds in his prime, he was noted for his fearlessness, and his arms and hands were covered with scars where carnivores, parrots and big birds had ripped into his flesh. One arm was marked by a long scar where a black panther had slashed him. On five different occasions he had been forced to sew himself up when wounded by animals far from civilization. His face bore scars as the result of the "affectionate" reactions of a large male chimpanzee which he had not seen for several years.

Ellis Joseph was a true zoologist, ecologist and comparative psychologist. His knowledge concerning the morphology and behavior of various birds and mammals was unexcelled. He was particularly eager to cooperate with scientists throughout the country, and would often go out of his way to supply a laboratory with desired research animals. Once, rather than sell the body of a young gorilla for less than it was worth, he donated the animal for study to a well-known comparative anatomist. He was an honorary life member of the American Museum of Natural History and of the Philadelphia Zoological Society.

Mr. Joseph had the universal respect of all those who knew him. His reputation was impeccable; his word was his bond. He was exceedingly generous and a most gracious host. He sought perfection, and had a singular love for the unusual and the esoteric; these were reflected in everything that he had and did.

Ellis Stanley Joseph is dead. He has joined Carl Akeley and Martin Johnson, and has completed the triumvirate. But his spirit lives on in the African bush, Australian plain, Tibetan highland and Malayan jungle, as well as in the memories of those who knew and loved him.

JOHN P. FOLEY, JR.

DEPARTMENT OF PSYCHOLOGY,
THE GEORGE WASHINGTON UNIVERSITY

RECENT DEATHS

DR. E. W. RETTGER, professor of applied mechanics at Cornell University, died on October 9 at the age of sixty-seven years.

DR. RAEMER REX RENSHAW, professor of organic chemistry at New York University, was killed on September 23 by a fall from the window of his apartment. His wife was killed at the same time in the same manner. Dr. Renshaw had been on leave, but was expected to resume his work at the university on September 28. He was fifty-eight years old.

THE death is reported in *Nature* of Sir Philip Dawson, a distinguished electrical engineer, who received the George Stephenson Gold Medal of the Institution of Civil Engineers and also the Albert Medal of the Royal Society of Arts, on September 24 at the age of seventy-one years.

DR. F. J. KARL SUDHOFF, professor of the history of medicine at the University of Leipzig and founder of the German Society for the History of Medicine, died on October 14. He was eighty-four years old.

THE death on June 30 at the age of seventy-five years is reported of Dr. Waichiro Okada, honorary professor of otorhinolaryngology at the Tokyo Imperial University and president of the Showa Medical College, which he founded.

SCIENTIFIC EVENTS

HURRICANE DAMAGE TO THE STATIONS OF THE BUREAU OF FISHERIES

It is reported in the *Bulletin* of the Fisheries Service that several of the bureau's stations were in line of the hurricane which visited the New England States during the week of September 19. Fortunately, no injury was suffered by members of the personnel. Superintendent Goffin of the Woods Hole, Mass., station writes in regard to the situation there:

> You have probably been informed of my telegrams to the commissioner relative to the hurricane and tidal wave which struck this village the afternoon and night of September 21. The wind and sea were terrific, the east dock and sea wall is practically gone, the coal dock, west dock and south docks are badly damaged, the capstones of the sea wall have been knocked out. All basement windows and doors of the residence building are smashed; this basement had 6 feet of water which has been pumped out by the local fire department. We were able to get up steam on the boiler and syphon out the hatchery building. Six of our pontoons are a total loss, having been swept out to sea; the sea entered the buildings through the front door and basement windows. The slate roofs of both the residence and the hatchery building are badly damaged. The fence along the street has been mostly carried away and the grounds between the residence and sea wall are badly washed out. The boilerhouse had 3 feet of water, but this disappeared when the waters receded, leaving very little damage there; the basement of the residence building has a great deal of debris, seaweed and sand washed in from the sea. We are without lights and can not cook until the gas company gets its mains in operation. I am happy to say that out of all this havoc our boat, the *Phalarope II*, was damaged very little so far as I can now see. The salt water suction pipe line, where it lay along the wall, is practically all destroyed. As it is now, the property and the *Phalarope* are without protection against the winter storms due to the loss of the east side sea wall.

The Nashua, N. H., station was damaged by the uprooting of a number of trees which caused injury to buildings and damage to the ponds. It is estimated that the amount of $15,000 will be necessary to rehabilitate this station. Both the Gloucester, Mass., and the Boothbay Harbor, Maine, stations escaped without any appreciable damage. At the Pittsford, Vt., hatchery the creek overran the station grounds and flooded out the ponds. The brood stock was thoroughly mixed, but comparatively few fish were lost. Mr. Lord, in charge at Pittsford, reports, however, that many wild trout were undoubtedly destroyed, since they were discovered stranded, in numerous instances, along the line of débris marking the high water. A bridge, the property of the bureau, was washed out, but the structure was to be razed within the next few days.

The oyster laboratory at Milford, Conn., escaped damage, although the Yacht Club building located next to the station was demolished and a large number of elm trees surrounding the station and along the street leading to it had fallen. The station grounds were under from 1 to 3 feet of water, but all the equipment and material had been placed on higher shelves or otherwise made secure.

THE PRACTICE OF MEDICINE AND THE PRACTICE OF CHEMISTRY

An attempt to deprive chemists of the right to direct clinical laboratories in Pennsylvania is being opposed by the American Chemical Society. The society, according to an announcement made by the secretary, Dr. Charles L. Parsons, of Washington, D. C., has filed a brief through its attorney, A. J. Nydick, of Philadelphia, with the Attorney General of Pennsylvania setting forth "the clear demarkation between the practice of medicine and the practice of chemistry."

Dr. Parsons states that:

> Evidence in the possession of the society shows that there has been an organized effort to wrest from the chemist his natural position in the field of factual investigation in the laboratory. This evidence shows that the attempt originates with a small group of laboratory physicians with obvious self interests.
>
> The method adopted is to have the existing law so interpreted by the State Board of Medical Education and Licensure as to make it unlawful for any one not having the M.D. degree, no matter how well qualified, to direct such laboratories.
>
> Between the practicing physician and the chemist who directs and operates a clinical laboratory there exist the most cordial professional relationships, but, notwithstanding the esteem in which the qualified chemist is held by the practicing physician and in spite of a joint resolution adopted in 1924 by the American Chemical Society, the American Medical Association, and the American Association of Pathologists and Bacteriologists with respect to the rights of chemists, certain organizations of physicians affiliated with the American Medical Association have seen fit to support the contentions of the small group which is attempting to monopolise the directorships of clinical laboratories.

The brief describes the scope of the science of chemistry, recalls medicine's indebtedness to chemistry, defines a clinical laboratory as a specialized chemical laboratory, and declares that "the right to pursue a profession is a property right which is protected by the Constitution of the United States."

The Board of Medical Education and Licensure, it is explained, has taken the position that the 1936 amendments to the Medical Practice Act of 1911 so enlarged the Act that "the operation of a clinical laboratory now constitutes the practice of medicine."

The society, on the other hand, contends that clinical laboratories are not engaged in the practice of medicine, but rather are laboratories for the practical application of chemistry and the other fundamental sciences "wherein are made such factual investigations for the physician as he may desire in the study of his patients." Laboratory investigation, it is asserted, is not diagnosis of diseases because the physician must integrate laboratory findings with all other relevant clinical data in reaching a diagnosis.

THE ELI LILLY PRIZE IN BIOLOGICAL CHEMISTRY

ATTENTION is again directed to the Eli Lilly and Company Prize in Biological Chemistry, an annual award whose purpose is to stimulate an interest in fundamental research in biological chemistry on the part of young men and women in the United States. It was established by Eli Lilly and Company in 1934 for a five-year period and is administered by the American Chemical Society. The award is the sum of $1,000 together with a bronze medal and $150, or as much thereof as is needed, to defray the traveling expenses of the recipient to the spring meeting of the American Chemical Society where he formally receives the honor and gives an address describing the work on which the award is given.

To be eligible for the award, a nominee shall not be over thirty-five years of age on April 30 of the year of the award and shall have accomplished outstanding research in biological chemistry, working in a college or university. For the purpose of this award biological chemistry does not include immunology, clinical investigations, pharmacology or experimental therapeutics, and outstanding research is understood to be that which is of unusual merit for an individual on the threshold of his career. The research is not to be judged in comparison with the work of more mature and experienced chemists, and special consideration is given to the independence of thought and the originality and resourcefulness shown.

The award is made by an award committee of seven, consisting this year of Charles A. Kraus, president-elect of the American Chemical Society, as chairman, and the following non-industrial biological chemists appointed by the president-elect: Wm. Mansfield Clark, Glenn E. Cullen, R. Adams Dutcher, H. B. Lewis, P. A. Shaffer and D. D. Van Slyke. Nominations of the award must be made as follows:

> Nominations for this award should be sent to the secretary of the society by any member of the society except the members of the Award Committee. No member may send in more than one nomination. Nominations shall be accompanied by a brief biographical sketch of the nominee, including date of birth, and by reprints of his publications, with specific reference to the research on which the nomination is based. At the time of the nomination the nominee must be actively engaged in the line of research for which the award is to be made. The sketch, information and reprints should be in the form of seven copies for distribution by the chairman of the members of the Award Committee.
>
> All nominations to be considered must be received by the secretary of the society on or before January 5, 1939.
>
> In order to insure that no outstanding young chemist shall be overlooked, a Nominating Committee of four, appointed by the president of the society, is charged with the duty of finding worthy nominees for the award, by themselves searching the literature and suggesting his nomination to individuals familiar with his work; also, by writing to others who are in a position to judge the qualifications of individuals and to make worthy nominations.
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> The members of the present Nominating Committee are H. A. Mattill, University of Iowa; Lawrence Bass, Mellon Institute, Pittsburgh; V. du Vigneaud, Cornell University Medical College, New York City, and Ben H. Nicolet, U. S. Department of Agriculture, Riverdale, Maryland. The members of this committee wish to receive and exchange suggestions with regard to suitable candidates.
>
> The nominations themselves, together with the substantiating documents, should be sent directly to the Secretary of the American Chemical Society, Dr. Charles L. Parsons, Mills Building, Washington, D. C.
>
> If in the opinion of the Award Committee there is no outstanding nominee from a United States college or university, the award may be passed and the fund used for a later award.
>
> The chemist selected will receive the prize at the Baltimore meeting of the society next spring.

The nominating committee requests that information regarding this prize be disseminated as widely as possible and especially that it be brought to the attention of those who are located in college and university centers of biochemical research.

APPOINTMENTS AT THE MEDICAL COLLEGE OF VIRGINIA

THE session opening the second century of the Medical College of Virginia began on September 19. Faculty promotions for the session 1938–1939 include:

Dr. Stuart Michaux, professor of gynecology; Dr. R. H. Courtney, professor of ophthalmology; Dr. R. Finley Gayle, professor of neuropsychiatry; Dr. Thomas W. Murrell, professor of dermatology and syphilology; Dr. Lee E. Sutton, Jr., professor of pediatrics; Dr. William D. Suggs, assistant professor of gynecology. Dr. Wyndham B. Blanton, who resigned last session as professor of history of medicine, has been made associate professor of medicine. Dr. Joseph F. Geisinger has been appointed professor of clinical urology.

In recognition of many years of service to the institution the following have been made emeritus professors following their retirement on July 1, 1938: Dr. St. George T. Grinnan, emeritus professor of pediatrics; Dr. Emory Hill, emeritus professor of ophthalmology; Dr. E. P. McGavock, emeritus professor of dermatology and syphilology; Dr. Charles R. Robins, emeritus professor of gynecology, and Dr. Beverley R. Tucker, emeritus professor of neuropsychiatry.

In the School of Dentistry Dr. Grant Van Huysen has resigned as assistant professor of anatomy and Dr. Alton Brashear has been appointed in his place as associate in anatomy. Dr. Webb B. Gurley has resigned as assistant professor of operative dentistry and Dr. H. D. Coy has joined the staff as professor of operative dentistry. Dr. A. Hubert Fee has been promoted to assistant professor of operative dentistry.

In the School of Pharmacy Dr. J. A. Reese has returned from the University of Florida, where he recently completed his work for the Ph.D. degree. He has been made assistant professor of pharmacognosy.

In the School of Nursing Miss Frances H. Zeigler, dean of the school of nursing, and Miss Lulu K. Wolf, associate professor of nursing, have resigned to accept similar positions at Vanderbilt University. Miss Ann Parsons has been made acting dean of the school of nursing for the session 1938–39.

The Public Works Administration has made a grant of $880,623 towards the construction of a new sixteen story hospital and the rehabilitation of the historic Egyptian Building. The total construction cost is estimated at $1,920,441.

IN HONOR OF DR. AUGUST KROGH

The honorary degree of doctor of science was conferred on Dr. August Krogh by Rutgers University on October 11. Dr. Krogh was one of the principal speakers at the dedication of the new research laboratory of the Squibb Institute for Medical Research at New Brunswick. The presentation of Dr. Krogh was made by Dr. William H. Cole, professor of physiology at the university. He said:

> All of us who are engaged in research in physiology, wherever our researches may have been conducted, have in spirit, at least, sat at the feet of Dr. Schack August Steenberg Krogh. Dr. Krogh first won international recognition when he received the Vienna Academy of Science prize for his work on the gaseous exchange in lungs.
>
> Brilliant investigator of respiration, he published in 1916 his authoritative volume on "Respiratory Exchange in Animals and Men." In a related field he extended his researches to the functions of the capillaries, and in 1920 was awarded the Nobel Prize in physiology and medicine. While Silliman Lecturer at Yale, he published in 1923 his second authoritative volume "The Anatomy and Physiology of Capillaries." Subsequently he has boldly attacked other secrets of nature, investigating life in salt and fresh water, studying the effects of heavy water on organisms and the innervation of cold spots in the skin. His example and influence, Mr. President, have stimulated the efforts of physiologists the world over and greatly augmented our wealth of scientific knowledge. I have the honor to present Dr. Schack August Steenberg Krogh for the honorary degree of Doctor of Science.

The citation made by President Robert C. Clothier read:

> Dr. Krogh, your long and distinguished pursuit of truth among the mysteries of life has lighted dark places in the borderland of human knowledge. You have exerted a profound influence upon the endeavors of your fellow physiologists. Your researches have enriched our scientific heritage. With the approval of the trustees of Rutgers University it is my privilege to confer upon you, honoris causa, the degree of Doctor of Science.

SCIENTIFIC NOTES AND NEWS

Professor R. H. Fowler, at his own request for reasons of health, has been released from the engagement to assume the directorship of the British National Physical Laboratory in succession to Dr. W. L. Bragg. Dr. Charles Galton Darwin, master of Christ's College, Cambridge, has been appointed in his place. For the period until Dr. Darwin can take up the work, the office of director will be held by Sir Frank Smith, secretary of the Department of Scientific and Industrial Research.

The evening lecture at the autumn meeting to be held at the University of North Carolina of the National Academy of Sciences will be given on the evening of Monday, October 24, by Dr. E. C. Stakman, professor and head of the department of plant pathology at the University of Minnesota. His subject will be "Plant Disease Fungi Constantly Evolving New Types."

A portrait of Dr. Henry A. Christian, physician-in-chief at the Peter Bent Brigham Hospital, was presented to the hospital corporation on October 13. Dr. Christian will retire next year. The portrait was accepted by William Amory. Dr. Elliott C. Cutler, surgeon-in-chief, spoke of Dr. Christian as "a man whom we deeply respect and greatly admire, one whose devotion to this hospital and whose name will travel down the years as part of our institutional tradition."

The doctorate of laws was conferred at the closing session on October 14 of the seventy-fourth convocation of the University of the State of New York on Dr.

James Rowland Angell, president emeritus of Yale University and educational counselor of the National Broadcasting Company. He was presented with the degree by Owen D. Young. Dr. Angell was professor of psychology at the University of Chicago from 1894 to 1920.

Dr. Gordon W. Allport, associate professor of psychology at Harvard University, was elected president at the recent Columbus meeting of the American Psychological Association.

Officers of the American Dairy Science Association for next year are: *President*, Professor Earl Weaver, East Lansing, Mich.; *Vice-president*, Dr. E. S. Guthrie, Cornell University, who under association rules will automatically become president next year; *Secretary*, Professor Robert B. Stoltz, of the Ohio State University; *Directors* elected to serve for three-year terms are Professor J. W. Linn, extension specialist in dairying, Kansas State College, Manhattan, and M. E. Parker, Beatrice Creamery Company, Chicago. At the annual meeting to be held next June, the program will be divided between the state agricultural colleges at Moscow, Idaho, and Pullman, Washington, which are only nine miles apart.

Before sailing for New York on October 1, Dr. Henry Hanson, traveling representative of the Pan American Sanitary Bureau, was decorated with the Order of Merit of the Ecuadorean Government, in recognition of his services in Ecuador in fighting the bubonic plague. The decoration was presented by Dr. Leopold Izquieta, secretary of education.

Dr. Richard P. Strong, since 1913 professor of tropical medicine at the Harvard Medical School, has retired from active teaching and has been named professor emeritus.

Professor Hugh Gray Lieber, of Long Island University, and Dr. L. R. Lieber, director of the Galois Institute of Mathematics, have been appointed visiting professors of modern mathematics in the Graduate School of Duquesne University, Pittsburgh.

A department of forestry has been established at the Illinois Experiment Station, under the directorship of Dr. John Nelson Spaeth, who has been assistant professor of forestry at Cornell University and silviculturist of the Cornell station. Associated with him will be J. E. Davis, extension forester of the college and the State Natural History Survey, and L. B. Culver, assistant in forestry extension.

Dr. Gregory Pincus has been appointed visiting professor of experimental zoology at Clark University. Dr. N. T. Werthessen and Dr. Mark Graubard have been appointed research associates to collaborate with Dr. Pincus in his studies of the mammalian egg.

Dr. Elbert C. Cole, professor of biology at Williams College, has received a research grant for study at the Marine Biological Laboratory at Woods Hole, Mass.

At the University of London, Dr. F. R. Winton, reader in physiology at the University of Cambridge, has succeeded Professor J. H. Gaddum in the chair of pharmacology; Dr. H. H. Woollard, professor of anatomy, has become head of the department of anatomy and embryology, on the retirement of Professor J. P. Hill from the chair of embryology; Dr. G. R. de Beer, formerly lecturer at the University of Oxford, has been appointed reader in embryology.

Dr. Harold James Plenderleith has been appointed deputy keeper in charge of the Research Laboratory of the British Museum, in succession to Dr. Alexander Scott, who has been honorary director of the laboratory since its establishment in 1919.

Dr. Kemp has been appointed director of the Danish Institute for Human Heredity and Racial Hygiene of the University of Copenhagen.

Dr. Harold J. Conn, chief of the department of research in soil bacteriology in the New York Agricultural Experiment Station at Geneva, N. Y., and chairman of the Committee for the Standardization of Biological Stains, has taken up special work at the Scripps Institution of Oceanography of the University of California, where he plans to stay until the end of the year. He is making a study of the growth of soil bacteria in synthetic or prepared soils, using materials found in deep-sea bottom deposits.

Dr. Comfort A. Adams, Abbott and James Lawrence professor of engineering and Gordon McKay professor of electrical engineering, emeritus, at Harvard University and consulting engineer to the Edward G. Budd Manufacturing Company, Philadelphia, has been appointed a member of the advisory committee of the thirteenth Exposition of Power and Mechanical Engineering, to be held in New York City from December 5 to 10.

Dr. Dugald C. Jackson is preparing for the Engineers Council of Professional Development a report on trends in engineering education, in which he has the cooperation of Dr. Dugald C. Jackson, Jr., formerly director of the Lewis Institute of Chicago.

Dr. Alexis Carrel, of the Rockefeller Institute for Medical Research, returned to New York on October 8. He will carry on his work at the institute during the winter.

Dr. Barnum Brown, curator of fossil reptiles at the American Museum of Natural History, and O. S. Chapin, of Calgary, Alberta, left New York on September 15 for an aerial survey for dinosaur remains over Montana and the province of Alberta, Canada. A new model Fairchild plane will meet the party at Billings, Mont., the starting point of the survey. The principal bases will be Calgary and Edmonton.

DR. PAUL S. MARTIN, chief curator of the department of anthropology at the Field Museum of Natural History and leader of the archeological expedition which has made during the season of 1938 an extensive survey in Montezuma County, Colorado, and the adjoining country, returned to Chicago on October 16. It will now be possible from the data and artifacts collected to construct a complete sequence of the history of the earliest known inhabitants of southeastern Colorado—the prehistoric Basket-maker Indians who occupied the region from about A.D. 600 to 1200.

DR. EMMANUEL FRITZ, associate professor of forestry in the University of California, has leave of absence for three months in order that he may assist in the preparation of a report on the coordination of forestry activities in the Department of the Interior. While in Washington he will be stationed in the Division of Forests.

DR. ARTHUR H. COMPTON, professor of physics at the University of Chicago, lectured at a convocation at Wayne University on October 17. His address was entitled "Shall Science Point the Way?"—a discussion of the relationship between scientific and religious thought.

PROFESSOR WALTER MULFORD, head of the Division of Forestry of the College of Agriculture of the University of California, delivered the principal address at the convocation of the University of Michigan on October 7, when the thirty-fifth anniversary of the founding of instruction in forestry was commemorated. Professor Mulford was a member of the department of forestry from 1905 to 1911. He spoke on the progress and policies of the Michigan School of Forestry.

DR. A. V. KIDDER, chairman of the Division of Historical Research of the Carnegie Institution of Washington, is giving on Monday and Thursday afternoons, beginning on October 17, a series of eight Lowell lectures on "The Pre-Columbian New World" in the lecture hall of the Boston Public Library.

IN order to meet the need for pathologists skilled in the diagnosis of tumors, the Surgeon General of the Public Health Service has announced that in making appointments for training under the provisions of the National Cancer Institute Act, special consideration will be given to qualified pathologists who wish to secure additional training and instruction in the pathology and diagnosis of tumors.

SEVERAL Benjamin Peirce instructorships at Harvard University are open for the academic year 1939–1940. These instructorships are ordinarily awarded to men who have recently received the Ph.D. degree or have had equivalent training. Those interested in applying should write to the chairman of the Division of Mathematics.

ACCORDING to the constitution of the American Society of Naturalists, members may submit to the executive committee names of candidates for membership. Such nominations must remain in the hands of the executive committee for at least one year before action can be taken upon them. Members of the society are invited to send nominations at this time to the secretary, Ralph E. Cleland, department of botany, Indiana University, Bloomington, Ind.

THE Premio Alvarenga do Piauhy (Brazil) Prize for 1939, about $200, will be conferred by the College of Physicians of Philadelphia on July 14, 1939, upon the author either of the best memorial or of the best unpublished essay on any branch of medicine which may be deemed worthy of the prize. In selecting the winner of the award the committee will consider recent publications brought to its attention prior to May 1, 1939; also unpublished typewritten manuscripts submitted to the committee before that date. Manuscripts not in English must be accompanied by a translation into English.

THE School of Medicine of the University of Pennsylvania will receive eventually the bulk of the estate of the late Dr. George E. de Schweinitz to found a chair of ophthalmology. Except for one bequest of $6,000, the estate of $105,000 was left in trust for a sister of Dr. de Schweinitz. After her death $5,000 will go to the College of Physicians of Philadelphia and the residue to the university. His medical library is left to the College of Physicians.

WESTERN RESERVE UNIVERSITY came into possession of the principal of the Albert Fairchild Holden Trust Fund on August 25, which was the twenty-fifth anniversary of the death of the late Liberty E. Holden, who established the foundation as a memorial to his son. The fund, which, at a conservative estimate, is said to be worth a million and a half dollars, will continue to be used, as directed by Mr. Holden, for lectures and research in the School of Medicine. The trustees of the foundation are Ben P. Bole, I. F. Freiberger and Guerdon Holden.

THE estate of the late Richard Crittenden McGregor, an ornithologist who was attached to the Philippine Bureau of Science for nearly thirty-five years, has presented to the Museum of Vertebrate Zoology of the University of California his collection of Philippine and Alaskan bird specimens. The collection includes approximately eight hundred specimens, some of the species being now extinct.

The U. S. Coast and Geodetic Survey has erected a new building at the seaward end of the 1,200-foot pier of the Scripps Institution of Oceanography at La Jolla. It is forty-five by ten feet and is part of a general program of improving the recording tide-gauge stations. Dr. G. F. McEwen, official tidal observer of the U. S. Coast and Geodetic Survey at the Scripps Institution, has been put in charge of construction. In addition to the instruments used in the tidal work, the building will contain equipment for routine observations of meteorological and hydrographic conditions, and for biological studies.

By a cooperative agreement recently concluded between the U. S. Department of Agriculture and the Iowa State College, the statistical laboratory of the college will undertake to perform important services for and with the department, and to this purpose it is increasing both staff and equipment. Provision is made for the addition to the staff, of which Professor G. W. Snedecor is director, of a professor of mathematical statistics, an instructor, four graduate assistants, two collaborators and a sufficient number of clerical assistants. The purpose of the enlarged laboratory is research in the statistics of agriculture and associated statistical theory. One project is the study of the relation between weather and crop yield. Weather conditions to be considered are change and range of temperature, rainfall, wind. Partial census methods—whose investigation is of great concern to the laboratory—are used for the estimation of acreage and condition of the crop, for the sake of early prediction of yield. In the study of weather prediction, the Massachusetts Institute of Technology is cooperating. Products to be given early consideration are corn, wheat (with the aid of Kansas State College) and cotton. By the study of sampling techniques it is hoped to be able to learn significant economic and social facts of rural life more efficiently and reliably. A further topic of investigation is the analysis of time series.

During the recent crisis in Great Britain the aeroplane of 1903 in which the Wright Brothers made their first flight, which has been exhibited on loan in the Science Museum, South Kensington, for the past ten years, was removed to a place of safety in the vaults of the museum.

DISCUSSION

THE HISTORY OF MATHEMATICS FORTY YEARS AGO

In 1898 the publication of the now widely used "Encyklopädie der mathematischen Wissenschaften" was begun. The first article thereof relates to arithmetic and includes a considerable number of historical statements relating to this subject. It may be assumed that these statements represent about the highest mathematical attainments at the time when they appeared, since this is the most extensive recent mathematical encyclopedia, and more than 200 scholars of various countries cooperated in its preparation. Hence it may be of interest to compare the views contained in some of these statements with those which are now current with a view towards noting progress along various mathematical lines during the last forty years. In particular, the historical statements may be of wide interest, since they can be readily understood and relate to the early training of almost all educated people.

Since note 18 on page 12 of Volume 1 contains an especially large number of statements which have been disproved since their appearance therein we begin with several of these assertions. This note relates to negative numbers and in the third sentence thereof it is asserted that the first traces of these numbers appear in the works of the noted Indian mathematician Bhaskara (born in 1114) who distinguished between the positive and the negative square root of a number. It is now well known that, on the contrary, even the Indian mathematicians used negative numbers more than 500 years earlier and that, in particular, Brahmagupta (born in 598) placed a dot above a number to indicate that it is negative. It is therefore far from correct to say that the first traces of negative numbers appear in the work of Bhaskara. In the following sentence of the given note it is asserted that the Arabs recognized negative roots of equations, which is also now well known to be untrue.[1]

The last sentence of the given note contains two misstatements relating to R. Descartes (1596–1650). The first of these is that the actual calculating with negative numbers begins with R. Descartes, while it is now commonly known that such calculatings are posterior to R. Descartes as is also stated in the corresponding note (149) of the French edition of this encyclopedia, page 35 (1904). The said second misstatement in the sentence is that R. Descartes gave to the same letter sometimes a positive value and sometimes a negative value, while, on the contrary, R. Descartes always assumed that a letter represents only a positive number when it is assumed to have a numerical value. It is, however, true that by placing a dot before a letter R. Descartes implied that either a positive or a negative number may be assigned to the letter.

[1] *Cf.* Tropfke, "Geschichte der Elementar-Mathematik," Volume 2, page 97, 1933.

Although note 24 (page 21) of the article in question involves comparatively few incorrect assertions it contains one which is so extremely bad that the note as a whole is perhaps even worse than the note 18 to which we have referred. In the former it is stated that the sexagesimal system of the ancient Babylonian astronomers involved 59 different numerical symbols. This would correspond to the 9 different digits in our decimal system, but there is no historical evidence that such a complex early system ever existed. It is now well known that the ancient Babylonian sexagesimal system was partly based on the number 10 and that the numbers up to 60 were represented with respect to this smaller base.[3]

It is not implied that all the historical notes in the widely used encyclopedia noted in the opening sentence of this article are in need of radical revision. On the contrary, the majority of them are still reliable, especially those which relate to the more advanced parts of our subject. It may, however, be of interest that some of these notes which relate to the most elementary parts of our subject should now be used with great caution, since historical progress during the last decade or two has been especially rapid with respect to school mathematics, where it might have been least expected. In particular, the history of negative numbers as it is presented in some of our general histories of mathematics is very misleading notwithstanding the fundamental rôle of these numbers in various developments relating to school mathematics. It is questionable whether in any other large field of mathematics the progress during the last forty years has been more profound than in its history.

G. A. MILLER

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MEDITERRANEAN SEDIMENTS AND PLEISTOCENE SEA LEVELS[1]

THE magnitude of the sea level changes during the glacial stages of the Pleistocene are of interest not alone for their bearing on the origin of submarine canyons but also, among other things, for their effect on migrations of animals and plants. Antevs[2] and Daly[3] have independently suggested that the sea level was lowered 80 to 90 meters during the last glacial stage, whereas Shepard[4] has suggested that it was lowered perhaps as much as 900 meters.

An independent test of the hypothesis that sea level was lowered several hundred meters would probably be furnished by a study of the sediments in the western deep basin of the Mediterranean Sea. Long cores of these sediments, like the cores that Dr. C. S. Piggot obtained in 1936 from the North Atlantic, would probably make available the sedimentary record of post-Pleistocene time and part of the last glacial epoch.[5] Such records should be conclusive on the question of great lowering of ocean level because the unusual configuration of the Mediterranean Sea floor and the geographic setting make the hydrography not only peculiar but also sensitive to changes of ocean level and of climate.

Lowering the ocean level about 320 meters or more would profoundly alter the hydrography, and this would be reflected in the deep basins by the formation of varved sediment moderately rich in organic matter like that now forming in the Black Sea.

Lowering the ocean level considerably less than 320 meters, say 80 or 90 meters, would not give rise to varved sediment in the western of the two deep basins, though the glacial climate alone would probably give rise to varves in the eastern deep basin.

Lowering the ocean level 80 or 90 meters would affect the regimen of sedimentation less decisively, yet it seems that the effect should nevertheless be distinguishable, as is outlined below.

In order to show how these conclusions are reached it will be necessary to consider the present hydrography of the Mediterranean and the probable hydrography that existed during the last glacial stage when both the climate and the ocean level were different. A high sill at the Strait of Gibraltar separates the Mediterranean from the Atlantic and a comparable sill at the Sicily Straits divides the Mediterranean into two deep basins (Fig. 1). Over the crest of the sill at Gibraltar the deepest water is approximately 320 meters. In the Sicily Straits the deepest channel across the crest of the sill is 450 meters. These constrictions in the longitudinal profile have a significant bearing on the hydrography.

At present the Mediterranean Sea loses more water by evaporation than it receives from its tributary streams and from the overflow of the Black Sea. In consequence its level is maintained by influx of sea water from the Atlantic. The loss of water by evaporation is greatest in the eastern Mediterranean, so that the Atlantic water, with salinity of about 36 parts per thousand, drifting eastward becomes progressively more saline until near the Syrian coast it reaches a

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[3] *Cf.* O. Neugebauer, "Vorlesungen über Geschichte der Antiken Mathematischen Wissenschaften," Volume 1, page 4, 1934.

[1] Published with the permission of the Director, Geological Survey, U. S. Department of the Interior.

[2] E. Antevs, *Amer. Geog. Soc. Research Ser.*, No. 17, p. 81, 1928.

[3] R. A. Daly, *Bull. Geol. Soc. Amer.*, 40: 724–725, 1929.

[4] F. P. Shepard, SCIENCE, 83: 484, May 22, 1936.

[5] C. S. Piggot, *Bul. Geol. Soc. Amer.*, 47: 675–684, 1936; W. H. Bradley, M. N. Bramlette, J. A. Cushman and others, *Am. Geophys. Union Trans.*, eighteenth annual meeting, pp. 224–226, 1937.

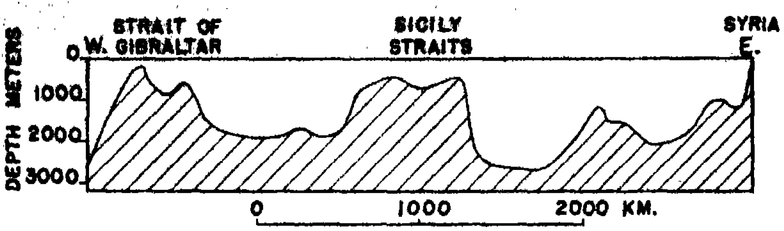

FIG. 1. Profile of greatest depth along the Mediterranean Sea.

salinity of about 39 parts per thousand and becomes so dense that, despite its increased temperature, it sinks to the bottom. This warm, heavy water then moves westward through the deeper parts of the Mediterranean, flows over the sill at Gibraltar, and thence flows down the continental slope till it reaches water of its own density (less saline but colder), where it spreads out in a great fan and eventually mixes with the ocean water. This slow circulation keeps the deep parts of the Mediterranean partly oxygenated, though in the western deep the supply of oxygen is small and the water contains a considerable percentage of carbon dioxide.[6]

Let us consider first what effect the climate of the last glacial stage had upon the hydrography of the Mediterranean Sea. According to Brooks[7] and according to the evidence from many sources assembled by Antevs[8] the climate was cooler and considerably more rainy than to-day. A greater volume of water would therefore have reached the Mediterranean from the increased rainfall and apparently also from the outlet of the Black and Caspian Seas because the Caspian, which then connected with the Black Sea, was receiving overflow from the Baltic and the Arctic.[9] Even under the present climate the Black Sea overflows, hence it seems safe to infer that this greater supply of water, together with the lessened evaporation rate consequent upon the cooler, stormier climate of the last glacial stage, would have caused the Mediterranean to overflow through the straits of Gibraltar. With enough fresh water entering to overbalance the loss by evaporation and cause overflow the hydrography should be analogous to that in the Norwegian fjords described by Strøm.[10] In those fjords a layer of fresh water floods the surface and protects the underlying deep body of salt water from the effect of the wind. Like the Mediterranean these fjords have a high sill at the seaward end. In many this sill is so high that there is room only for the stream of fresh water to pass over it. Thus the salt water in the fjord is sealed beneath a blanket where it becomes stagnant and ultimately charged with hydrogen sulfide. This sort of water stratification is stable and, curiously enough, more persistent the more fresh water flows across the surface of the dense saline water.[11] But in other fjords the sill is not so high and by reason of storms and abnormally high tides oxygenated and somewhat colder ocean water at least partially checks the outflow, pours over the sill, and mixes with and oxygenates the salt water in the deep part.

From this consideration of the Norwegian fjords we may infer that, even if the ocean level had not been lowered during the last glacial stage, the Mediterranean, because of the different climate, would have had a surface layer of essentially fresh water overlying the oceanic water that filled the deep basins. Furthermore, the oxygenated Atlantic water would have had free access to the western basin of the Mediterranean through the Straits of Gibraltar beneath the outflowing surface stream of fresh water and in consequence the deep water of the western basin would have continued to be at least partially supplied with oxygen. But with a blanket of essentially fresh water covering the Mediterranean and moving westward there appears to be no way in which significantly large volumes of the oxygen-bearing saline water in the western basin could move across the sill at the Sicily Straits so as to cause circulation and afford an oxygen supply in the deep saline water of the eastern basin. For this reason the water in the eastern deep basin probably would have become stagnant and depleted of oxygen soon after the climatic change permitted fresh water to flood the surface of the Mediterranean.

Now the stagnation engendered in the eastern basin by climatic change alone would have left an unmistakable record in the sediments that accumulated there. Under these conditions the stagnant water becomes poisoned with hydrogen sulfide, which kills off all the bottom fauna. With no bottom dwelling organisms to disturb the sediment and aid in the destruction of the organic matter the sediment accumulates as successive pairs of thin laminae, one of which is rich in organic matter and represents the annual pulse in the growth of plankton. The other part of the couplet usually consists of mineral particles with less or no organic matter and represents the remainder of the year. In short, varved sediments would have accumulated as they are accumulating to-day in the deep water of the Black Sea,[12] in certain Norwegian fjords,[13] in salt lakes in Crimea,[14] in the lake of Zürich[15] and in the deep, stagnant and lifeless parts of many other lakes and enclosed seas. Thus it appears that the sedimentary record of the eastern basin of the Mediterranean should reflect the marked climatic changes that accompanied the glacial stages of the Pleistocene.

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[6] For a full discussion of the Mediterranean hydrography see G. Schott, *Ann. Hydrographie und Maritimen Meteorologie*, 43 Jahrg., Heft 1: 1-18, 1915, and also *Jour. du Conseil*, 3: no. 1, pp. 139-174, 1928.

[7] C. E. P. Brooks, "Climate through the Ages," p. 315, 1926.

[8] E. Antevs, *Amer. Geog. Soc. Research Ses.*, No. 17, pp. 34-39, 1928.

[9] S. Eckman, "Tiergeographie des Meeres," pp. 141-142, 1935.

[10] K. M. Strøm, *Skr. Norske. vidensk. akad.*, Oslo, 1936, No. 7, pp. 7-59.

[11] G. E. Hutchinson, *Trans. Conn. Acad. Arts and Sci.*, 33: 116-127, 1937.

The following consideration of the hydrography of the western basin suggests that its sedimentary record would contain a decisive test of the hypothesis that ocean level was lowered several hundred fathoms during the last glacial epoch. Again the reasoning turns upon analogy with the Norwegian fjords, for, as outlined above, we can assume that the climate alone would have brought about hydrographic conditions in the western basin of the Mediterranean closely analogous with those of certain ventilated or oxygenated fjords discussed by Strøm.[16] If now the level of the ocean were gradually lowered nearly or quite down to the top of the Gibraltar sill the channels across the sills at Gibraltar and the Sicily Straits would be progressively constricted. The eastern basin would be still more effectively sealed, so we need consider it no further. But now the western basin would eventually stagnate and be depleted of oxygen. For some time oxygen-bearing Atlantic water would spill over the Gibraltar sill at high tide or when the wind piled up the water on the ocean side. But when the ocean level reached the level of the Gibraltar sill, 320 meters below present ocean level, or if it sank still lower, then the hydrography of the western basin of the Mediterranean would be like that of the Black Sea to-day. A blanket of essentially fresh water covering the sea, moving westward and overflowing the sill at Gibraltar would seal beneath it the deep body of salt water which, being thus cut off from its supply of oxygen, would become charged with hydrogen sulfide and varves would form in the bottom sediments like those in the eastern basin and like those now forming in the deep, saline, stagnant part of the Black Sea.

Hence it seems to me that organic-rich, non-glacial varves in the deposits of the deep parts of the western basin of the Mediterranean overlain by a considerable thickness (1 to 2 meters?) of limy coccolith and Globigerina ooze would be strong reason for believing that, during the last glacial stage of the Pleistocene, ocean level was lowered about 320 meters or more.

But if sea-level were only lowered 80 or 90 meters during the last glacial stage, as suggested independently by both Antevs[17] and Daly,[18] it seems likely that, although no varves formed, the sediments off the Algerian coast, and perhaps elsewhere along the Mediterranean, should contain legible records of lowered sea level, but the records would be of a different kind. Anderson's[19] interpretation of the Quaternary events along the coast of western Algeria indicate that during the interglacial stages when the sea level rose the valleys slowly filled with generally fine-grained alluvium and that during the glacial stages when the sea level dropped, large volumes of the alluvial deposits were removed from the valleys and carried into the sea. Thus the deposit formed off shore from these streams during the last interglacial stage should be a layer or bed of fine-grained limy mud, rich in pelagic organisms like coccoliths, foraminifera and pteropods —sediments with less clastic material than those forming there to-day. But during that stage when the sea level was falling the sediments formed off this same coast should be distinguishable from those of the interglacial and postglacial stages by their relatively great abundance of clastic material and probably also by different and colder water pelagic organisms.

Because the Mediterranean region is one of volcanic and seismic activity and because the sea itself is rather sensitive to climatic changes the post-Pleistocene history as recorded in the deep water sediments should be unusually legible.

The pelagic fauna of the Mediterranean was presumably quite different at the end of the last glacial stage, by reason of the greater volume of fresh or feebly saline water that flooded its surface. The more or less gradual change from that condition to the present hydrographic condition should be marked in the sediments, especially of the western basin, by the appearance of generally Atlantic types of coccoliths, pteropods and foraminifera which inhabit the surface waters now. Indeed, these forms may have reached a recognizable peak of abundance during the higher sea level of the "climatic optimum."[20] At some level, perhaps corresponding to late Neolithic time, when, according to Sandford and Arkell,[21] northern Egypt became desert, the wind-blown sand from the region south of the Mediterranean should begin to make its appearance. This wind-blown sand is abundant in the sediments forming to-day in the deep basins of the Mediterranean.[22]

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[12] A. D. Archanguelsky, *Bull. Soc. Naturalistes du Moscou*, new ser., 35: 264–281, 1927.

[13] K. M. Strøm, *op. cit.*

[14] B. W. Perfiliev, "Ten Years of Soviet Science," pp. 402–403, Moscow, 1927.

[15] Fr. Nipkow, *Rev. d'Hydrologie*, 4 Année, No. 1/2: 71–120, 1927.

[16] *Op. cit.*, pp. 42–59.

[17] E. Antevs, *Amer. Geog. Soc. Research Ser.*, No. 17, p. 81, 1928.

[18] R. A. Daly, *Bull. Geol. Soc. Amer.*, 40: 724–725, 1929.

[19] R. v. V. Anderson, *Geol. Soc. Amer., Mem.* 4: 363–376, 1936.

[20] C. E. P. Brooks, "Climate through the Ages," pp. 411–414, 1926.

[21] K. S. Sandford and W. J. Arkell, "Paleolithic Man and the Nile-Faiyum Divide," Univ. Chicago Press, vol. 1, p. 68, 1929.

Less vague, however, would be the record left by the activity of explosive volcanoes. A considerable number of these ash falls in the upper part of the post-Pleistocene column of sediments should be correlatable with human history. Earthquakes, too, should have caused submarine mud slumps that threw into suspension much sediment which settled as widespread blankets[23] of distinctive sediment. Such a blanket of sediment should show a gradation in grain size due to the differential settling rates of the constituent particles thus thrown temporarily into suspension.

It seems to me, therefore, that long cores of the sediments in the deep basins of the Mediterranean would probably reveal an extraordinarily rich and varied record in a locality critical not only by reason of the unusual configuration of the basin but also by reason of the wealth of information that is already available from the long historic records, the archeology and the Pleistocene and post-Pleistocene geology.

W. H. Bradley

TYROSINE DETERMINATIONS[1]

The author was recently engaged in a study of egg albumin in which it was necessary to run tyrosine determinations on small quantities of the protein. Since the method of Folin and Marenzi[2] requires 100 milligrams for each determination, and that of Lugg,[3] approximately 50 milligrams of protein, it was decided to use Lugg's method. It is for the purpose of discussing modifications of this method that this paper is presented.

In the method under discussion, that of Lugg, the 50 milligram sample of ovalbumin is hydrolyzed in alkali as recommended by Folin and Marenzi, acidified, centrifuged and a 3 ml aliquot diluted to 5 ml with 5 and 1 normal H_2SO_4 in such proportions that the 5 ml solution will be at a pH of 0.3 (from titration of a separate aliquot using brilliant cresyl blue as an indicator). It is common knowledge that no efficient indicator is available at this pH range and that the glass and quinhydrone electrodes are extremely inaccurate for this determination. In search of a simpler method of bringing the pH of the standard and unknown solutions to the same and required value it was discovered that one could very well utilize the normality of the test solutions with respect to H_2SO_4. When the 5 ml test solution is made 1 normal H_2SO_4 the buffer action of the amino acids in the solution and the repression of the ionization of the strong electrolyte (H_2SO_4), results in a pH of approximately 1. Block[4] states that a pH of 2.5 is also satisfactory. A series of analyses using the modification outlined here resulted in the following values for the per cent. tyrosine in egg albumin:

3.77; 3.83; 3.85; 3.81; 3.77; 3.83; 3.84
Mean 3.81

These values are close to the figures reported in the recent literature. Bernhart[5] reports 3.85 per cent. tyrosine in ovalbumin as determined by the method of Folin and Marenzi.

Further study of Lugg's method disclosed that another step could be modified for convenience. After the 5 ml test solution has been mercurated with a mixture of mercuric sulfate and chloride and made up to 25 ml, Lugg recommends that the sodium nitrite be added within an hour and compared colorimetrically with the standard (Millon reaction), since cloudiness may develop on longer standing and hinder the comparison. The following experiment was performed:

Six samples of egg albumin were treated simultaneously and in an entirely analogous manner according to the above discussed modification. After the solutions were made up to 25 ml, four samples were compared immediately, and the remaining two, twenty-four hours later. The results obtained from the two sets, in per cent. tyrosine present, are outlined below (the samples were previously treated in an oven for 24 hours at 110 C.).

	Analyzed immediately	Analyzed 24 hours later
	3.61	3.75
	3.67	3.68
	3.75	
	3.83	
Mean	3.72 per cent.	3.72 per cent.

These data can be interpreted to indicate that the test solution, diluted to 25 ml, can remain at least 24 hours before it is compared colorimetrically with the standard without any appreciable decrease in value of the tyrosine present.

The author wishes to thank Dr. L. Earle Arnow for his kind guidance in the work behind this paper.

Carl Reiter

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[22] K. Andrée, "Geologie des Meeresbodens," p. 263, 1920.

[23] Fr. Nipkow, *Rev. d'Hydrologie*, 4 Année, No. 1/2: pp. 70–120, 1927.

[1] From the laboratory of Physiological Chemistry, University of Minnesota, Minneapolis.

[2] O. Folin and A. D. Marenzi, *Jour. Biol. Chem.*, 83: 89, 1929.

[3] J. W. H. Lugg, *Biochem. Jour.*, 31: 1422, 1937.

[4] R. J. Block, "The Determination of the Amino Acids," Burgess, Minneapolis, Minnesota, page 21, 1938.

[5] F. Bernhart, Unpublished Ph.D. thesis, University of Minnesota, 1938.

SCIENTIFIC BOOKS

THE THEORY OF FUNCTIONS

Théorie Générale des Fonctionelles. By V. VOLTERRA and J. PÉRÈS. (Collection Borel) Paris, Gauthier-Villars, 1936. xii + 358 pp.

THE volume before us is the first in a series of three, the three together to give a résumé of something over fifty years of the work of Volterra. Although the complementary studies of others are given extensively and a systematic treatment is constructed, thus portraying the whole development of the subject, the exposition would nevertheless demand the attention of mathematicians of this generation, even if it limited itself to the inventions and discoveries of the author himself. Moreover, the author has the good fortune of having as collaborator Professor J. Pérès, who has made many contributions to the subject of functionals and integral equations. This volume and the other two in prospect, as well as the recent treatise, "Opérations infinitésimales linéaires," by Volterra and Hostinsky, form an amplification and modernization of the two volumes on functions of curves and integral equations published in the same Borel series on the theory of functions, some twenty-five years ago.

It is not necessary to detail the entire history of Volterra's contributions to this subject. But it is interesting to recall one or two steps. In the account of the meeting of the Lincei of June 15, 1884, appeared a short note "Sopra un problema di elettrostatica," which deals with the equation,

$$\varphi(x) = \int_o^a f(\alpha)\, F(\alpha, x)\, d\alpha, \quad o < x < a,$$

by means of variational methods. The significance of its result is best expressed in terms of the physical application: Given a conductor which is in the form of a symmetrical portion of a surface of revolution, subject to the action of insulators containing arbitrary charges of electricity provided that these are symmetrical about the axis of revolution, the equilibrium distribution on the conductor can be constructed in terms of the corresponding distribution of unit mass on the conductor when there are no inducing masses present. In 1887 we find these variational principles further developed as the sketch of a general theory of functionals; and also the study of linear differential equations in terms of the infinitesimal analysis of substitutions. In 1894 we have the algebraic theory of integral equations "of Volterra type." A man is indeed fortunate who sows in his youth the seeds of such a harvest.

The first half of the volume is devoted to the general theory of functionals. In this, we have the "passage from the discontinuous to the continuous," the relation to abstract metric spaces with the forms of the linear operator which depend on the various definitions of distance, a development of the calculus of functionals, and its relation to the calculus of variations. The author acknowledges the assistance of Professor Tonelli in this last section. These chapters are not to be taken as a substitute for treatises on metric spaces or calculus of variations, of which there already exist notable instances, but to introduce the reader to the general points of view which envisage them. Rather, there are emphasized the special developments of the theory of functionals itself on the basis of the special properties of one definition of distance, and for the sake of their applications.

The second part of the book deals with integral equations and comprises, as well as the classical theory, various developments in the direction of singular types, equations with multiple integrals, systems of equations and non-linear equations. It is not intended to be as nearly complete a survey as the detailed review of Hellinger in the Encyklopädie, but it is entirely readable and is supplemented by an extensive bibliography. The student will get from it the feeling of pressure outward, rather than the impression of in-breeding that one receives from so many sketches of the topic. One wonders when the subject of the numerical calculation and theoretical location of characteristic values will obtain the systematic development which may be hoped for from a subject as vast as the theory of functions of a complex variable (see for instance Section 35 of Hellinger's above-mentioned report).

There is some development of the "functions of composition," in which the symbolic product fg stands for the expression

$$\int_x^y f(x, \zeta)\, g\, (\zeta, y)\, d\zeta$$

or the corresponding integral with constant limits, the systematic treatment of this subject, with its numerous applications, being left to another volume. Of particular interest are the powers, positive, negative and zero. The power f^0 plays somewhat the role of an indicator of an operation to be performed; that is, f^0 itself may have no concrete interpretation, whereas $f^0\, g = g$. Whether or not there may be some advantage in separating the roles of unity by introducing a notation analogous to that of quaternions, as the reviewer did at one time, the questions at issue remain fundamentally the same; and the difficulties are in no sense to be obviated by a method of notation.

Altogether the reviewer has no hesitation in recommending the volume to the diligent attention of the student, and looks forward himself to the publication of the later volumes. In particular the reader will find that the treatment serves to give content to those more abstract studies of metric spaces, which indeed have been created in large part out of the fecundity of this topic of functionals.

G. C. Evans

Termite City. By Alfred E. Emerson and Eleanor Fish. With a foreword by William Beebe. Illustrations by Keith Ward. Pp. 127, 37 ills. Rand, McNally and Company, New York, 1937. $1.50.

The inexhaustible store of most interesting natural history pertaining to termites has been tapped in this book by Professor Emerson out of his long accumulated riches of information about this greatly diversified group of social insects. He sets forth in non-technical language the organization of the termite colony; the functions of the several castes; the varied structures found in termite houses; the periodic swarming of the alates; the care of king, queen, eggs, soldiers and larvae; the guest insects found in termite colonies; the destructive activities of cellulose-eating species; and the past history and evolution of the group. A fully annotated glossary adds technical information helpful to the non-specialist reader.

Termites are rather closely related to cockroaches and are thus among the oldest insects known, being found in the carboniferous strata and fully preserved in amber. Although rather simple and generalized in basic structural pattern they are highly evolved in social organization and in structures and instincts related to this mode of life, as shown in the limitation of reproduction to a single pair in the colony, with enormous increase in size and rate of egg-laying in the queen and provision of second and even third form supplementary kings and queens capable of coming quickly into functional activity in the event of the death of either member of the primary pair, or in case of the breaking up of the primary colony by isolation of outlying extensions or transportation of a fragment of the colony to a new site. Other specializations are found in the soldier caste, which also may have second and third forms in the same species. Some of these develop powerful mandibles, while others are nasute types with glands exuding a sticky fluid for entangling enemies or a poison gas for destroying them. As in the case of the military forms among other social animals the soldiers sacrifice themselves for the good of the group, are unproductive and are faithfully fed by the workers; the latter in the more highly evolved termite families form a slave caste deprived of flight and the reproductive function.

More specialized still are the complicated instincts of each caste by which the social organization is conserved. As noted by Darwin in his discussion of the difficulties attendant upon his theory of natural selection, these extraordinary instincts are exhibited by individuals who leave no offspring, and their parents never exhibit these same instinctive behaviors. This may be a highly specialized form of recessiveness of characters linked with the capacity for normal sexual activity.

Professor Emerson brings out of his closet of termite skeletons some of the disjunct members which haunt a student of these perplexing activities in the termite colony. Most of the work of the colony is done by individuals which are blind. Their antennae and mouth parts have a variety of sense organs adapted by structure as tactile and chemical receptors, but auditory organs are lacking and visual ones occur only in a rudimentary state even in the alate phase. How then is coordinated activity established and maintained? How do the blind soldiers find their way to guard the portal of exit, space themselves in order according to rank about the queen, or along the line of march? How do workers without blue prints or supervising architect build earthen towers with a ventilating system, oriented to the points of the compass, or erect rain gutters on the trunk of a tree to shed water from the nest starting these structures at the top and bottom of the series and meeting in good form at the middle? Verily instinct covers a multitude of unsolved problems in the termite world.

Termites also give rise to another set of problems among termitophiles which live in their colonies, which as beetles of strange pattern and stranger behavior, with abdomens reflexed over their back with segmental spigots flowing with milk and honey for their hosts. The fact that termitophile insects come to smell like their hosts may explain their toleration by their otherwise cautious hosts, but their structural changes might perplex even an enthusiastic biochemist.

Termites destroy man's utilized cellulose, preempt his fertile lands in the tropics by massive earthen structures, often sheltering fungus gardens. These are so durable that the recovery of the land for agriculture is unprofitable, though the termite mortar is good road metal. Termites also reduce forest waste, rapidly returning fallen trees to the soil, thus building up humus. They also facilitate erosion and help in building up alluvium and sedimentary deposits. The volumetric aspect of their relation to nature and man is based upon their social activities. The termite colony, given favorable conditions within reach of their exploratory habits, is practically immortal. It is fascism without a Hitler imposing its Kultur upon every individual and ever demanding room for more colonies.

Charles A. Kofoid

SPECIAL ARTICLES

VOCAL PITCH DURING SIMULATED EMOTION

The present report is limited to consideration of the pitch of the voice during simulated emotion. It differs from previous studies in two respects: (1) Identical reading materials were used in simulations of all emotions studied; (2) the effectiveness of the simulations was measured.

The test passage, "There is no other answer. You've asked me that question a thousand times, and my reply has always been the same. It always will be the same," was read by six competent amateur male actors to portray each of the following emotional states: Contempt, anger, fear, grief and indifference. Phonograph records of the readings were cut. The recordings were played before a group of 64 observers, in whose hands had been placed lists of twelve emotional states, among which appeared the five being studied, as follows: Amusement, anger, astonishment, contempt, doubt, elation, embarrassment, fear, grief, indifference, jealousy, love. The observers were asked to select from the list the term which named most accurately the emotion being simulated as each recording was played. A random order of presentation was used. From these judgments it was possible to rate the portrayals in terms of the percentage of the observers able to identify them.

Measurements of the fundamental sound wave frequencies employed were made from the phonograph recordings by phono-photographic techniques. The results of the analysis are presented in Table I. It will be understood that the measure listed as median pitch level in this table is the median fundamental frequency employed. It is referred to as "pitch level" to distinguish it from the concept of frequency level in octaves above 16.35 c.p.s., and because it is a term in common use among students of speech. The nearest musical tone is that on a musical scale where A = 440 c.p.s. Measures of range were computed by means of the relation $N_{\text{Tones}} = 19.92 \log_{10} \frac{f_1}{f_0}$, where f_1 is the higher and f_0 the lower frequency.

TABLE I

AVERAGE MEASURES OF PITCH

	Contempt	Anger	Fear	Grief	Indifference
Percentage of correct judgments	84	78	66	78	88
Median pitch level [cycles per second] ...	124.3	228.8	254.4	135.9	108.3
Nearest musical tone..	B_1	$A^{\#}_2$	C_3	$C^{\#}_2$	A_1
Total pitch range [tones]	10.5	10.8	11.2	9.0	7.8
Mean inflectional range [tones]	2.2	2.6	2.3	1.7	2.0
Rate of pitch change [tones per second].	16.8	25.6	19.0	15.6	16.6

That the simulations studied were characteristic of the emotional states is readily observed from the high percentage of correct identifications, as seen in Table I. Further reference to this table and to Fig. 1 shows that striking differences obtain between the median pitch levels measured for the different emotions. It will be observed that indifference employs a lower pitch level than any of the other readings and that each emotion appears to have a characteristic comparative pitch level different from other portrayals. A significant

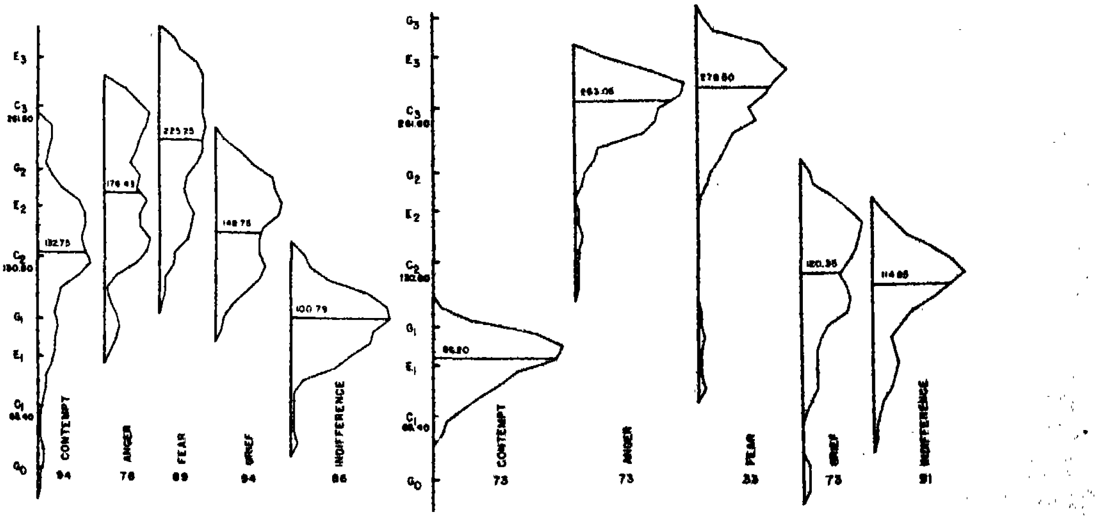

FIG. 1. Distributions of pitches used. The ordinate is pitch in semi-tone intervals; the abscissa, in the case of each distribution, is percentage of cases. Left, effective actor; right, ineffective actor. Medians indicated by horizontal lines across each distribution and labeled in cycles per second. Lower numbers show percentage of observers making correct identification.

fact is that pitch levels for indifference, contempt and grief are in the neighborhood of C_2, while those for anger and fear are approximately one octave higher at C_3.

Indifference employs the narrowest total pitch range, about an octave, with grief using a range of one and one half octaves, and contempt, anger and fear approximately two octaves. The distribution of pitches used within these ranges is observed from the graphs of the effective readings in Fig. 1 to approximate a normal distribution.

The mean extent of inflections (*i.e.*, frequency modulations either upward or downward) is seen to vary from one third to approximately one half an octave in extent. Grief employs the narrowest inflectional range and anger the widest, with the other emotions falling within the interval which separates these extremes.

An additional means of distinction between emotions is afforded by a measure of the rapidity with which pitch changes per unit of time during inflections. An expression of the rate of this change is given in tones per second by dividing the pitch range in tones of a given inflection by its duration in seconds. As with inflectional range, anger and grief are the extremes, with anger using the fastest rate of pitch change and grief the slowest, the difference being ten tones per second. The speed of pitch change for contempt and indifference is slightly more rapid than for grief, while fear exceeds this value by approximately two tones per second.

Fig. 1 presents distributions of the pitches used by typical effective and ineffective actors. It is interesting to note that the ineffective actor deviates markedly from the effective performer in all but indifference, in which both were judged as being highly effective. Examination of the figure shows that pitch levels for the poor readings are not defined as clearly as those for the better readings. The median pitch levels in anger and fear are almost identical, as are those in grief and indifference, while contempt, contrary to the effective as well as average measures, employs a pitch level which is considerably lower than other attempts by this actor. The latter's simulation of contempt uses also an extremely narrow pitch range of less than one octave, and the extremely wide ranges of his fear and grief are due to the presence of a few very low pitches. The above deviations represent the typical differences between effective and ineffective portrayals. It is probable that the ineffectiveness is the result, to some degree at least, of these extreme deviations from the average and effective simulations.

One striking result regarding pitch in emotional speech was obtained by computation of the total pitch range employed by each actor in portraying all five emotions. It was found that five of the six actors used a total pitch range of over three octaves.

From the above data it is possible to characterize each emotion comparatively on the basis of pitch usage alone, as follows:

(1) Contempt. (a) Low median pitch level (124.3 c.p.s.), but (b) wide total pitch range (10.5 tones).

(2) Anger. (a) High median pitch level (228.8 c.p.s.), (b) wide total pitch range (10.3 tones), (c) widest mean inflectional range (2.6 tones), (d) most rapid pitch change (25.6 tones per second).

(3) Fear. (a) Highest median pitch level (254.4 c.p.s.), (b) widest total pitch range (11.2 tones).

(4) Grief. (a) Low median pitch level (135.9 c.p.s.), (b) narrow total pitch range (9.0 tones), (c) narrowest mean inflectional range (1.7 tones), (d) slowest pitch change (15.6 tones per second).

(5) Indifference. (a) Lowest median pitch level (108.3 c.p.s.), (b) narrowest total pitch range (7.8 tones).

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PHOSPHORUS METABOLISM OF CHICKS AFFLICTED WITH PEROSIS

PEROSIS (slipped tendon) in chicks was first described by Hunter and Funk.[1] It has been studied by a number of investigators, and recently Wilgus, Norris and Heuser[2] have shown that the affliction can be corrected by raising the level of manganese in the ration. This observation has been confirmed by a number of investigators.[3]

The disorder is characterized by a bowing of the legs in the tibia—metatarsal joint, enlargement with a tendency toward flattening of the joint and finally slipping of the Achilles tendon from its normal position. Perosis has been produced by the feeding of high levels of calcium phosphate—3 to 5 per cent. of the ration. Our ration[4] for producing this condition is given in Table 1.

The addition of 50 mg of manganese as $MnSO_4 \cdot 4H_2O$ per kilo of the above rations protects the chicks from perosis. Injection of 1, 3, 10 or 50 mg of manganese per week, in two equal doses, also protects on ration 604. No data involving injection are as yet available with ration 610. Rice bran fed at the level of 15 or 20 per cent. protected on ration 604. Auto-

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[1] J. E. Hunter and E. M. Funk. *Proceedings* of the 22nd annual meeting of the Poultry Science Association, Macdonald College, Quebec, p. 45, 1930.

[2] H. S. Wilgus, Jr., L. C. Norris and G. F. Heuser. SCIENCE, 84: 252, 1936; *Jour. Nutrition*, 14: 155, 1937.

[3] V. G. Heller and R. Penquite, *Poultry Science*, 16: 243, 1937. M. Lyons, W. M. Insko, Jr., and J. H. Martin, *Poultry Science*, 17: 12, 1937. M. Lyons and W. M. Insko, Jr., *Ky. Agr. Exp. Station Bull.*, 371, 1937. P. J. Schaible, S. L. Bandemer and J. A. Davidson, *Poultry Science*, 16: 367, 1937.

[4] L. E. Clifcorn, C. A. Elvehjem and E. B. Hart, *Poultry Science*, 17: 28, 1938.

TABLE 1

	Ration 604	Ration 610
(Dried beef kidney 15)		
(Dextrin .... 48)	71	69
Crude casein	14	14
Brewer's yeast	2	2
Salts I	5	5
$Ca_3(PO_4)_2$	3	5
Alcoholic extract rice bran ..	5	5
Percomorph oil—3 drops twice weekly		

claved rice bran failed to protect. The ash of rice bran or the manganese equivalent to that of 15 or 20 per cent. of rice bran also failed to protect when fed with ration 604.

These observations led to an investigation of the phosphorus distribution in the blood of normal and perosis birds as well as the phosphatase content of the blood and bone. It was found that the inorganic phosphorus of the blood remained constant in both normal and slipped tendon birds and at a level of approximately 4.7–5.6 mg per 100 cc of blood. The ester phosphorus was approximately 26–30 mg per 100 cc of blood in the case of perosis, while the total phosphorus ranged from 100 to 141 mg per 100 cc of blood. In normal birds produced by feeding or injecting manganese, the ester phosphorus ranged from 32–44 mg per 100 cc of blood, while the total phosphorus varied from 100–132 mg per 100 cc of blood. The most characteristic feature of the phosphorus distribution in the normal and afflicted birds was a higher ester phosphate in the blood of the normal birds.

In respect to the phosphatase content of bone and blood of normal and slipped tendon birds, there was also a clear-cut difference. On ration 604—which produced 100 per cent. slipped tendon—the phosphatase content of the blood ranged from 2.1–3.1 units per 100 cc of blood and from 3.6–7.7 units per gram of green bone. In the birds protected by manganese feeding or injection at different levels, the phosphatase content of the blood varied from 15.9–51.3 units per 100 cc of blood and from 8.5–10 units per gram of green bone. It is apparent that in the complex process of normal bone formation, a high inorganic calcium phosphate ingestion had depressed the phosphatase content of blood and bone, and at the same time there had occurred a lowering in the ester phosphate level of the blood.

It is possible that the autoclaving of rice bran, which is then rendered ineffective as a protective agent, is linked with a destruction of the phosphatases of the bran. Since rice bran is rich in phytin—the calcium-magnesium salt of phytic acid—we raised the question as to whether there was a possibility that inositol (a constituent of phytic acid) might be concerned in the ester phosphate increase observed in normal birds as compared with those afflicted with slipped tendon. Feeding inositol on ration 604 at a level of .5 grams per kilo did not protect against perosis. Injection of inositol at the rate of 50 mg per week did not protect with ration 604. However, we have observed that with ration 610—containing 5 per cent. of calcium phosphate—and supplemented with 20 mg of manganese per kilo, there is no protection against perosis. The manganese level is not high enough. The ester phosphorus remains below 30 mg per 100 cc of blood and the phosphatase at 30 units per 100 cc of blood and 6.4 units per gram of green bone. When the chicks receiving ration 610 supplemented with 20 mg of manganese per kilo were injected with 100 mg of inositol per week, there was complete protection against perosis. The ester phosphorus rose to 34 mg per 100 cc of blood and the phosphatases of the blood to 40.5 units per 100 cc. With the same ration injection of 10 mg of inositol or of 100 mg of glucose per week did not protect. We hesitate at this time to state definitely that the increase in ester phosphorus of the blood by injection of adequate manganese or inadequate manganese plus inositol resulted in the formation of inositol esters of phosphoric acid, but such a possibility may well exist. So far as we know, no one has isolated from animal tissue phosphoric esters of inositol, although they are known to exist abundantly in the seeds of certain plants. Free inositol itself is known to occur in muscle and brain; however, its function has not been disclosed.

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THE GROWTH OF LEPTOSPIRA ICTEROHEMORRHAGIAE ON THE CHORIO-ALLANTOIC MEMBRANE OF THE CHICK EMBRYO

A WIDE variety of bacteria and viruses has been successfully grown in the tissues of the chorio-allantoic membrane of the chick embryo by a number of workers.[1] Up to the present time, however, no one has described the cultivation by this method of any member of the family *Spirochetales*. The purpose of the present note is to report the use of chorio-allantois of the chick embryo for the successful cultivation of *Leptospira icterohemorrhagiae*, the causative organism of Weil's disease (infectious spirochetal jaundice or *spirochetosis icterohemorrhagica*).

The strain of *Leptospira icterohemorrhagiae* employed was isolated at autopsy from the kidney of a man who died of Weil's disease at Rochester, N. Y., on February 19, 1937. The strain was maintained by passage in guinea pigs and by cultivation in Fletcher's medium.[2] On May 5, 1938, 0.1 cc of a positive culture was inoculated on the chorio-allantoic membrane of each of 10 eggs, incubated for 10 days, according to the method of Goodpasture and Buddingh.[3] Transfers were made every 4 or 5 days. To effect a transfer, 2 or 3 membranes were triturated in a mortar with Alundum and Locke's solution to make a 10 per cent. suspension. For the inoculation of each egg, 0.1 cc of this preparation was dropped on the presenting ectodermal surface of the chorio-allantois.

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[1] See reviews by F. M. Burnett, *Med. Res. Council, Sp. Rept. Series*, No. 220, 1936; also, E. W. Goodpasture, *Amer. Jour. Hyg.*, 28: 111, 1938.

The spirochetal organisms were carried through 20 successive passages in the developing egg. After each fifth passage, 1 cc of the "transfer inoculum"—the 10 per cent. suspension of triturated infected membranes—was injected subcutaneously into each of 2 guinea pigs. In every instance, the inoculated guinea pig developed fever within 4 or 5 days and became jaundiced. The infection was uniformly fatal in from 6 to 8 days. At autopsy, the characteristic findings of experimental Weil's disease in guinea pigs were encountered. Jaundice of the skin, jaundice and hemorrhages in the subcutaneous and cartilaginous tissues and hemorrhages in the lungs and abdominal viscera were typical.

The organisms were seen by the darkfield technic in centrifugalized "transfer inoculum" and in the amniotic fluid.

After inoculation on the chorio-allantois, the organisms regularly invaded the embryo. The resulting generalized infection killed the embryos in 6 or 7 days. The organisms have been recovered from the blood of the embryos and from various tissues by the inoculation of these materials into guinea pigs. It has been found that 0.15 cc of blood from the allantoic artery contain sufficient spirochetes to kill guinea pigs within the usual period.

Grossly, the membranes showed scattered, grayish, opaque, pin-point nodules. Microscopically, the nodules were seen to be the result of a localized proliferation of ectodermal cells, and of edema, proliferation of the fibroblasts and infiltration of a few inflammatory cells in the mesoderm. Sections of infected chorio-allantoic membranes and embryos, stained according to the silver impregnation technic of Levaditi, revealed the presence of *Leptospira icterohemorrhagiae* in both the membranes and embryos.

In summary, it has been shown that *Leptospira icterohemorrhagiae* can be successfully cultivated in the chorio-allantoic membrane of the chick embryo. The organisms produced a generalized and fatal infection in the developing chick. After 20 serial passages in the embryonic tissues, the pathogenicity of the spirochetes for guinea pigs was unaltered. Indeed, virulence may have been enhanced. An attempt is being made to grow other members of the family *Spirochetales* by this method.

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SCIENTIFIC APPARATUS AND LABORATORY METHODS

AN IMPROVED APPARATUS FOR THE SERIAL SECTIONING OF FOSSILS

In 1933 Simpson (*Amer. Mus. Nov.* No. 634) described a very simple method of producing serial sections of fossils to which the reader is referred for the actual technique. Without claiming to introduce something essentially new it is suggested that the apparatus then described is capable of certain improvements, making it less delicate to handle, and at the same time increasing its accuracy. The number of components is even smaller, and the actual execution is still within the scope of any mechanic provided with an ordinary instrument-maker's lathe. The overall length of the new design is greater than that of the original construction, which may even be an advantage affording a better grip. This greater length is due to the holder being extended to carry a millimeter scale above the threaded portion, the pitch of the thread being one mm. The sleeve on its conical upper end is divided into 100 parts, the two scales together forming a micrometer reading to 0.01 mm. This arrangement prevents the locknut being placed above the sleeve. Instead it has been placed inside the latter and is made in one piece with the guide. Its lower edge stands 0.5 mm behind the lower edge of the sleeve. A suitable spanner with two studs fitting the two holes in the lower rim of the guide (locknut) is used for tightening it. If a right-hand thread is used the scales should read in the direction given in the diagram.

The advantages claimed are the following: absence of the delicate pointer, which is easily bent; the threads are covered and thus protected from injury; the scale is an integral part of the sleeve, doing away with the sticking on of a paper-scale; mistakes in taking the readings are less to be feared.

In order to reduce wear of the lower edge of the sleeve a ring could be shrunk on to it, either of hardened steel, or better still, of one of the modern cutting metals like Stellite, Acrite, etc. In this case it might be necessary to use kerosene oil instead of water for

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[2] W. Fletcher, *Trans. Roy. Soc. Trop. Med.*, 21: 265, 1928.

[3] E. W. Goodpasture and G. J. Buddingh, *Amer. Jour. Hyg.*, 21: 319, 1935.

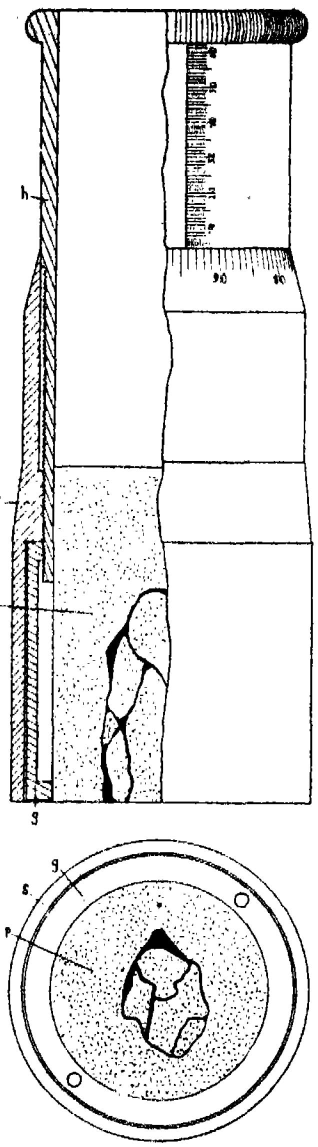

FIG. 1. Improved specimen holder for grinding serial sections. The upper figure represents, to the right, a lateral external view of the apparatus, and, to the left, a longitudinal section. The lower figure represents an end view. Both show a plaster block, with embedded specimen, in place at a stage when a section has just been completed. About one half natural size. g, guide for the plaster block, also serving as set-screw. h, holder. p, plaster block with specimen. s, sleeve.

the cleaning of grinding stone and specimen in order to prevent rust.

OTTO ZDANSKY

A MICRO-CONDUCTIVITY CELL OF SIMPLE DESIGN[1]

IN some recent studies of the rate of elimination of materials by the excretory system of insects, we have made use of the change in electrolytic conductivity of the physiological salt solution bathing the malpighian tubules as an indicator of change in overall salt concentration.

Since the volume of liquid was only about 20λ, it was necessary to use a conductivity cell of 10λ volume or less. While several micro-conductivity cells have been described,[2] they are not easily constructed, and they do not have the advantages of the pipette type in ease of filling and cleaning. Fig. 1 shows the complete cell, right, and a detail of the electrodes, left. For construction, pyrex capillary tubing of about 0.7 mm bore was broken cleanly and one of the cylindrical platinum electrodes with the lead attached was inserted and shaped to fill the tube, using a finely drawn glass rod as a tool. The two pieces of capillary were then reunited in a soft oxygen flame, taking care that the platinum cylinder completely filled the bore of the tube. The tube was then broken again at a second point and the second electrode was inserted in the same manner. Finally, the tip and safety bulb were formed, and the electrodes were ready for platinizing.

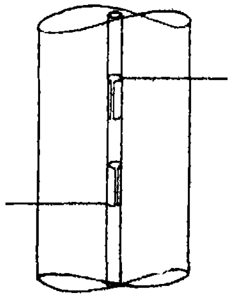

FIG. 1

A cell, as described, will have a resistance of about 2,000 ohms when filled with 1 per cent. NaCl solution. The cell resistance is accurate to 0.1 per cent. at constant temperature.

RODERICK CRAIG
ROBERT L. PATTON

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[1] From the laboratories of insect physiology and toxicology, Division of Entomology and Parasitology, University of California, Berkeley, California.

[2] See, for example, H. L. White, *Jour. Biol. Chem.*, 99: 445, 1933.

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BOTANY OF THE FUTURE[1]

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DEFINITION

THE speaker has been assigned the task of discussing botany of the future. Perhaps we should first define the term botany. If one were to ask an educated layman or even a specialist in plant science, he would undoubtedly get the glib definition that botany is the science of plants. This is an extremely broad definition, but is it the content of the term that the layman or specialist really has in mind? Is not the layman inclined to think of botany in the limited sense of collecting, classifying and naming plants? However this may be, in this paper botany will be used in the broad sense of the dictionary definition including all plant science.

There are two implications in this assignment that the speaker must limit. First, "Botany of the Future" implies a prophetic effort, and second, botany is a science made up of several distinct disciplines, each too big for the complete mastery by one person. The speaker claims no prophetic power and feels none too competent in his own limited field of plant physiology. It will have to suffice to give a brief history of botany, with especial emphasis on the more recent trends, and from these decide on some of the probable future trends in botanical research and development with merest reference to the meaning of botany to other sciences and to man.

THE STRUGGLE TO MAKE BOTANY AN INDUCTIVE SCIENCE

Before and immediately following the beginning of the Christian era the Greeks and Romans wrote much about plants. Their statements were based on casual observations, no experiments and much speculative thinking. Their descriptions of plants were often so inaccurate that later workers could not identify the plants by the descriptions. Perhaps the confused state in which they left the idea of sex in plants illustrates best their inability to gain knowledge of plants by studying plants themselves. In this connection they discussed some of the palms in which the stamens and pistils are borne on separate individuals. In such cases accurate observation and certainly a minimum of experimentation would have established the existence of sex.

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[1] Address before the American Association for the Advancement of Science in the conference on Science and Society, Ottawa, June 28, 1938. This address with the literature citations is to be published in full later by the association.

The slight contributions of these early Greek and Roman writers to real knowledge of plants do not justify the mention of their work in the present connection. On the other hand, the Aristotelian deductive and speculative method of approaching plant problems and some of his concepts dominated botanical thought throughout the Middle Ages and prevented the development of an inductive approach. Sachs (Sachs *ibid.*) points out the influence that Aristotelian methods of thought and dogmas had upon Linnaeus, the father of systematic botany, who worked during the eighteenth century.

Even the influence of Aristotelian thought upon Linnaeus would not justify its discussion in this connection. The speaker feels, however, that the discussion is justified by the fact that the botanical workers even to-day are too much given to speculation and to theories and too little to well-planned and searching experiments that will gain from plants themselves the information sought. We will refer to this point again later when discussing the topic, "Theories often impede progress."

HISTORY OF CERTAIN PHASES OF BOTANY

Let us now outline briefly the history of the development of only two of the many phases of botany. This will give us an insight into the nature of botanical research and the type of problems met. It will also give us a background for understanding some of the larger botanical problems of to-day and the immediate future.

Plant nutrition. Any considerable understanding of plant nutrition had to await the development of modern chemistry. It is true that prior to this Malpighi and Hales had gained evidence that much of the dry weight of green plants comes from the air. During the last half of the eighteenth century a series of discoveries set, at the same time, the background for an understanding of plant nutrition and for the development of modern chemistry. Priestley discovered "vital air," oxygen, and showed that green parts of plants sometimes give off oxygen. Lavoisier and Cavendish discovered the composition of carbon dioxide, water and nitric acid, and the former discovered the nature of respiration in animals. In the meantime Ingen-Housz, even under the misleading influence of phlogiston chemistry, had discovered two reverse types of processes in green plants which we now know as carbon-synthesis, or photosynthesis, and respiration.

But Saussure in 1804 laid the real foundations for plant nutrition when he established and extended by quantitative methods the findings of Ingen-Housz that green portions of plants in light absorb carbon dioxide from the air and transform it into some sort of organic material and set oxygen free in the process. He also showed that living tissue carries on respiration which eliminates CO_2 and consumes oxygen. Saussure proved also that the greater part of the dry weight of plants came from the CO_2 of the air and from water absorbed from the soil. One can hardly overemphasize the significance of the discovery of these two basic cosmic biological processes. Carbon-synthesis supplies the world with practically all its organic matter, including food, fiber and shelter, and some sort of respiration is a universal manifestation of living matter. Saussure also proved that the relatively small amounts of salts absorbed with the water play an essential rôle in plant nutrition. Thus he established in outline, practically as we know it to-day, the inorganic nutrition of green plants.

The next great advance in plant nutrition was the discovery of the chemical elements other than carbon, oxygen and hydrogen that are essential for plant development. The greater contributors to this knowledge were Boussingault, the French agricultural chemist, Liebig with his clear forceful statement of his theory of mineral nutrition of green plants, the various tenets of which were later tested out and corrected by Law and Gilbert at Rothamsted Experimental Stati Nobbe and Sachs of Germany, who contribute to the knowledge of mineral nutrition of green s by their nutrient solution studies. Out of all the w on plant nutrition up to the early part of the second half of the nineteenth century came the doctrine of the ten essential elements for plant nutrition, namely, carbon, hydrogen, oxygen, calcium, potassium, magnesium, iron, phosphorus, sulfur and nitrogen. Further studies by agricultural chemists led also to the fertilizer doctrine of three essential fertilizer elements, N, P and K.

These two doctrines of essential chemical elements and of essential fertilizer elements were both due to suffer modifications by extension because of researches carried on during the present century. The early students of plant nutrition failed to discover various essential chemical elements for plants that are needed in very small amounts because they failed to purify sufficiently the nutrient salts used or because of other errors in experimentation. Anyway in addition, boron, copper, zinc and manganese have been established recently as essential for the nutrition of some, if not all, plants, and a number of other chemical elements benefit the growth of one plant or another when supplied in small quantities in the form of salts. Soils have also been found in which certain plants grow very poorly, due to deficiency or lack of availability of one or another chemical element besides N, P and K. Amongst the recently found soil deficiencies are iron, sulfur, boron, copper, zinc and manganese.

What are some of the future problems in plant nutrition?

We have progressed far since the time of Saussure in learning the effect of conditions upon the rate of carbon fixation, and we have learned something about enzymes and much about the chemistry of the pigments involved in photosynthesis, but we have still to learn the exact details of the reactions and are therefore unable to duplicate carbon-synthesis outside the plant. In respiration also we have learned much about substances oxidized, about various organic substances produced by respiration and fermentation and something of the enzymes involved in these processes. The detailed understanding of carbon-synthesis and respiration are big chemical problems of the future.

Botanists are just now reinvestigating the essential chemical elements for plant nutrition as well as chemical soil deficiencies by sufficiently accurate methods to arrive at proper answers. This, however, is a minor future problem in plant nutrition. The big problem in this connection is the exact functions performed by the various chemical elements in plant nutrition and growth. We know much about symptoms caused by the lack or deficiency of the several elements. It is also easy to assign at least one function to elements like *nitrogen*, *phosphorus* and *sulfur* because they are built into organic compounds essential for life, but it is more difficult to find the function of potassium, copper, boron, etc. When we know all the functions of all the essential chemical elements for plant nutrition we will come near knowing all about plant life.

Chemical control of plant development. The study of chemical control of growth and development of plants is one of the latest fields of botany to get attention. Practically all the significant experimentation in this field comes within the last quarter of a century and the greatest progress within the last decade.

Perhaps the most interesting chemical modification of plant development is that caused by organic substances of the hormone type (Boysen-Jensen). In 1893 Julius Sachs announced the theory, based on rather general observations and experiments, that every plant organ (leaf, root, stem, flower, etc.) was initiated in plants by some stimulating substance (chemical) produced by the metabolism of plants. It is interesting that this theory was announced for plants some years before the discovery of the first animal hormone, secretin, by Bayliss and Starling (1902), while definite experimental knowledge of plant hormones came many years later. Sachs's theory had little experimental evidence to support it until Boysen-Jensen (1911) published his work showing the significance of chemical substances in the oat coleoptile in determining its growth and tropic response to light.

Following Boysen-Jensen's early work much knowledge has accumulated upon the effect of organic chemical regulators upon plant development (Zimmerman). Amongst the effects are: causing of tropic responses of plant organs to light and gravity, probably by the unequal distribution of the chemicals in the two sides of the organ; inducing cell elongation; initiating roots and other cell proliferations; inducing leaf epinasty; and completely or partially inhibiting growth of plant organs.

In contrast to the control of animal metabolism and development by endocrines the chemical control of plant development seems to be far less specialized; a number of chemicals that are very different in molecular size produce the same effects on plants, also chemicals that are not known to be produced by plants themselves act like plant hormones. The first point is illustrated by the fact that the four unsaturated carbon-containing gases (carbon monoxide, ethylene, acetylene and propylene), also certain indole, naphthalene and phenyl aliphatic acids, as well as the salts and esters of these acids, have similar effects on plant development; they initiate roots and cause other cell proliferations in plants, and they induce epinasty of leaves and act as growth inhibitors. While there seems no doubt that several of the effective substances mentioned above are not synthesized by plants at all, or at least not in sufficient amounts to modify growth, such a conclusion must be reached only after careful investigation in case the substance is effective in extremely low concentration. Either on the weight or molecular concentration basis ethylene is the most effective chemical known for modifying the development of certain plants. Recently, contrary to earlier assumption, it has been shown that most living plant tissues produce ethylene and that ethylene is a plant hormone which regulates development and induces ripening.

While several organic substances have been found to be effective in inducing roots, we have much yet to learn about organic compounds that initiate and regulate growth of buds and flowers. We know that some plants are induced to flower by long daily illumination, while others flower only on short daily illumination, also underground storage organs develop on certain plants only under short daily illumination. There is reason to believe that these and many other light effects are caused by the amount or type of organic regulators synthesized and maintained by plants under the influence of light.

The very important discoveries made in chemical regulation of plant development during the last few years have been of great assistance to investigators in other lines of botany and to practical propagators. The number of problems that are now opened up in this field, and the great number of investigators now engaged in the work indicate that this is to be a very productive field of plant research in the immediate future.

This is a very brief history of the development of only two of the many general problems that have been met in botany. Because of limit of time these two examples will have to serve as pictures of the nature of the problems met in botany and the methods used in their solution. These brief sketches also bring us face to face with some of the big problems to be met in the field in the immediate future.

BOTANY SPLITS INTO MANY DISCIPLINES

During the last part of the nineteenth and the first part of the twentieth century botany split into many separate sciences on three distinct bases: (1) on the basis of the phase of plant life studied (systematics, morphology, anatomy, physiology, cytology, genetics, phytochemistry, etc.); (2) on the basis of plant groups studied (bacteriology, mycology, algology, etc.); and (3) on the basis of the economic use made of various plants (agronomy, horticulture, floriculture, forestry, etc.). Let us make the situation more complex and shock the zoologists by claiming certain phases of entomology as a part of botanical science; one would not progress far in plant culture without the control of insect pests, and insects are necessary for pollination of many flowers and play an important, sometimes an intricate, rôle in transmitting virus and other plant diseases. Each one of these disciplines has discovered many facts about plants and established certain principles concerning them. As a result there exists to-day a great body of knowledge about plants that is not broadly enough correlated. There are indications that the next great step in the study of plants is the correlation and development of these several sciences into a comprehensive botany.

COMPREHENSIVE BOTANY OF THE FUTURE

The splitting of botany into many disciplines is evidently an artificial procedure. It does, however, separate the problems out so they can be readily defined and made capable of attack even by one individual. No considerable progress is made, however, in any problem of a given discipline of botany until the worker finds need of the help of other disciplines for the complete solution of his problem. Likewise, progress in his own problem is sure to throw light upon problems in several other fields of botany.

Of course all science has essential interrelations and may therefore be considered a unit, but the interrelation between the several disciplines of a subject like botany are so intricate and so numerous that the development of the several disciplines in closest relation with each other is suggested. The project method of attacking plant problems is becoming more common in agricultural and other plant research institutions. In the project method several individuals who know the more important technics for the solution of a problem work together, that is, they attack the problem from a variety of angles working each line alone but consulting frequently for mutual help and inspiration. There is also a move toward organization of institutions that cover many phases of the subject. If such institutions are to be most effective they must bring together individuals trained in all the main disciplines of botany as well as a large sprinkling of individuals trained in the several branches of chemistry and physics which, after all, in the broad sense, furnish a great part of the technic for botany. There is of course no advantage in the project-institute type of organization over the departmental type of organization unless the scientists representing the different disciplines work together, but the cooperative spirit in botany is also increasing.

I predict that the next great advance in botany is a synthetic one, in which all the disciplines will develop in intimate relation with each other, resulting in a unified comprehensive botany of the future.

EXAMPLES OF BOTANY ADVANCING PRODUCTION

Now let us consider a few cases in which botanical research has aided production. The illustrations are chosen, not because of the magnitude of their effect on production, but because the relation between the research and improved production is so direct that it can not be questioned. These illustrations must be considered, however, as only a few of the thousands of ways in which botanical research has increased the power of man to produce food and other commodities needed by him.

Plant pests. Some years ago a disease of cabbage—cabbage yellows—threatened to wipe out the cabbage industry. Dr. L. R. Jones, of Wisconsin, saw a 20-acre field in which only a few heads were perfect and without disease. He said, "These plants are probably resistant to yellows." He grew seeds from these, and through many years of selection and intensive study produced resistant forms that grow perfectly in diseased soil.

Just prior to 1900 a leafhopper was introduced into Hawaii from the South Sea Islands that threatened to completely wipe out cane production in the Hawaiian Islands. Several years of study and work by entomologists led to the introduction from the native home of the leafhopper insect parasites that completely controlled the pest. We have already claimed certain phases of entomology as a part of botany, so the last illustration is quite to the point.

These are but two of many cases of control of diseases or insect pests on useful plants. What is more important, a background of scientific information and principles has been established that will insure the control of plant pests in the future.

Crop nutrition. In northwestern United States it was discovered that the soil was deficient in sulfur. By adding sulfur compounds to the soil, alfalfa yields could be raised as much as five-fold. The discovery that pineapples grown in various soils of Hawaii were starving for iron because the iron in the soil was insoluble and that the iron had to be fed through the leaves as an iron sulfate spray made possible the development of the large pineapple industry in Hawaii. Recently, non-productive peat soils of Holland and the United States have been found to be deficient in copper. By addition of copper the soils become highly productive vegetable lands. Many other similar examples could be mentioned of increased production that resulted from supplying soil deficiencies.

Breeding better plants. Breeding and selection has done much to improve useful plants. Dr. William Saunders and his son, Dr. Charles Saunders, by 15 years of breeding and selection of wheat, produced Marquis wheat, the present spring wheat of western Canada. This wheat has about six days' shorter growing season than the Red Fife, which it displaced. It thereby misses fall frosts, which results in an increase in yield of nearly 30 per cent.

Hybrid maizes which resulted from basic genetic studies and which are just now coming into cultivation in the United States are a striking example of breeding increasing crop yield. Java's cane-breeding work, stretching over a period of more than 20 years, has produced the new P.O.J. canes that, under identical cultivation methods, produce three times as much sugar per acre as any of the canes entering into the original crosses. More than 15 tons of sugar per acre per crop have been produced. With these new canes and with improved methods of cultivation now known, two islands, Cuba and Java, besides growing much other food for their people, can produce with profit all the sugar the world can eat at two cents a pound at the mills.

It would require volumes to tell the complete story of the service of botany to man economically, medically and esthetically, but these statements will have to suffice for this paper.

Effective Methods for Botanical Research

We have just discussed the effectiveness of the project basis of organization for botanical research and the desirability of having in close association in botanical departments or institutions all types of technics necessary for the complete solution of plant problems. Let us mention some other methods or points of view that are now proving effective in botanical research and that need special consideration in the future development of the subject.

Equipment for plant research. The complexity of the future problems in botany will call for a great variety of technics and for greater and greater accuracies in measurements. To meet these needs the botany laboratories of the future will require much very accurate physical, chemical and biological apparatus. In addition, there should be apparatus for the growth of plants on a considerable scale and under a great range of controlled conditions as to light, temperature, humidity, etc. A research man should not be forced to guess at his results because of the inaccuracy of the apparatus. It is more productive to have fewer scientists and better equipment if finance is a limiting factor. One must also remember that equipment is paid for once, requiring of course a slight operating expense and occasional renewal, while salaries are a continually recurring charge against a project.

Dangers of over-organization for botanical research. The real discoveries in botany are made by the scientist coming into face-to-face contact with the plants and plant materials being studied and these contacts should be made with unburdened and alert minds. There is no doubt that over-organization and over-direction often interfere with this simple direct relation between the botanist and the material he is studying. Assuming of course that the workers are prepared for and adapted to their work, it is not direction but constructive suggestions and inspiration that they need from their fellow workers in order to make greatest progress.

Theories often impede progress. The method of attacking problems by the use of hypotheses makes every step of research directive and logical. The problem to be solved is stated; on the basis of established knowledge several hypotheses are set up, any one of which may be the solution of the problem; and finally each hypothesis is tested out by logically organized experiments. In case none of the first set of hypotheses proves to be the solution of the problem, the process is repeated until the solution is found. The very logic of the procedure may lead the investigator into a pitfall. Will he, before he has sufficient experimental evidence or because of numerous inferential agreements, dignify one of the hypotheses to the position of an established theory? There is no doubt that some investigators have a "theory psychosis."

Recently Farr and Eckerson discovered the real composition and structure of cellulose as it exists in the cotton fiber and other cell walls. It seems impossible that this discovery could have been delayed so long, considering that the cellulose industries in the United States alone produce more than a billion dollars worth of cellulose materials each year, and further, considering that botanists have been examining cell walls of plants with microscopes for a full century.

During the period 1852 to 1858 Nägeli developed his micellar theory of the structure of cellulose walls. According to his theory the cotton fiber is made up of cellulose particles or crystals too small to be seen with the microscope, but of such shape and arrangement as to account for the changes in the dimensions of the cell walls when swollen in water, and for the image produced when polarized light is passed through the wall.

Finally, Farr and Eckerson looked at developing cotton fibers through the microscope, and believed their eyes. They found that the cotton fiber consists of microscopically visible spheroid particles of cellulose cemented together by pectin-like substances such as cause fruit juices to form jelly.

I need not emphasize the significance of this discovery to the understanding of plants, because practically all plants produce cellulose walls. The importance of it is quite as evident to our billion dollar cellulose industry.

This is one of many cases in plant research where theories have impeded progress. Theories and hypotheses are useful in shaping experiments, but the truth about things must be learned by studying the things themselves in a face-to-face approach.

Accidental discoveries. Of course the botanist must proceed in his research on the logical basis mentioned above; there is no substitute for thoroughly planned and carefully executed experiments for solving the problem under consideration. On the other hand, the investigator should always be on the lookout for unexpected reactions that do not fit into the hypothesis under consideraion or that may not even be relevant to the problem under study.

A few years ago Dr. Pupin gave his retiring address as president of the American Association for the Advancement of Science, covering his years of research on air communication. From his address it seemed that most of his big discoveries were chanced upon when he was looking for something different.

Pure research in botany a misleading concept. The distinction between pure and applied knowledge or research probably originated with the Greeks. Slaves did the work for the Greeks; dealing with practical things or even with the objective was not the field for thinkers. The masters were metaphysicians, and, while they talked much about the nature of existence, they failed in the main to study the things that existed. Best progress in research with plants requires that one forgets this distinction between pure and applied research and pursues the studies wherever they will add to knowledge.

Perhaps there is no field of science in which we can as little afford to draw a line between pure and applied research and knowledge as in botany. Boussingault, the French agricultural chemist, and the Rothamsted Experimental Station early added much to our knowledge of plant nutrition and to-day agricultural experiment stations and similar institutions in the study of practical problems are continually adding important basic knowledge to nearly every phase of botany. Finally, the conditions met in a laboratory are limited and principles established in the laboratory need to be tested and modified as to limitations and breadth of significance by tests under the more varied conditions in the field and in nature. In this way only will we arrive at a complete knowledge of plants in all their relations.

ECONOMIC AND SOCIOLOGICAL IMPLICATIONS OF BOTANY

Citizens take a serious interest in botany. Throughout the history of man, plants have been amongst the most intimate objects of his environment. Also they have been the sole ultimate source of his food and clothing and the source of much of his shelter. In spite of this the average man has had little essential knowledge about plants. The serious and intelligent interest of people in botany is now increasing very rapidly.

Many of our farmers and others interested in plant production have been trained in agricultural colleg and still more in agricultural high schools. This training has given them some basic knowledge of plant nutrition and soil fertility, plant breeding, fungal and insect pests and various other phases of botany.

The increasing interest in gardening, especially ornamental gardening, is indicated by the rapid growth in the membership of garden clubs. No doubt the initial interest of such amateur gardeners manifests itself mainly in growing and knowing the names of plants for beautifying home grounds or in the arrangements of flowers for artistic effect in the house. On the other hand, many of these amateurs are interested in collecting and cultivating ecological groups of plants, such as rock plants, or systematic groups, such as lilies, begonias and iris. Many also are breeding and producing new forms of the groups that interest them. The number of books published for amateur gardeners is increasing rapidly and improving from year to year as to basic knowledge on propagation, plant nutrition and soil fertility, control of plant pests, breeding and other phases of the subject.

Because of the agencies mentioned above as well as others, more people are continuously becoming interested in and acquiring basic knowledge about plants. Plants develop in accordance with fixed laws, consequently serious study of them leads to factual thinking, a thing so desirable to the citizens of a republic.

Botany affects economics. Adam Smith's prediction of the eighteenth century that increase in population would overtake the capacity of the earth to produce food for the population and Malthus's further development of this idea both preceded any considerable knowledge of plants. A century and a half after this prediction the problem is not, Can we produce enough food for the population of the earth, but How can we dispose of what we do produce with production curtailed far below capacity? What changed this sad picture of a century and a half ago with a very cheerful one so far as ability to produce food for subsistence is concerned?

Neglecting for the moment other unexpected changes such as decrease of birth rate with rise in standards of living (the latter contrary to the postulates of the two economists), there are two big advances that have brought about his change: (1) invention of farm machinery which increased enormously the power of the individual to produce food and (2) the growing knowledge of botany in all its phases which has made production much more effective. With farm machinery now developed and with information about plants already established, every population on earth could be adequately fed with production at a fraction of capacity. There is still something to be done in improving farm machinery, and botany is still in its infancy; there is also a large part of the productive land of the earth, especially in the tropics, untouched by the plow. Because of the development of farm machinery and the great advance in knowledge of plants, feeding the world is no longer a problem of production but one of distribution.

PHILOSOPHY INTERPRETS SCIENCE

It is sometimes enlightening to get the view-point of men who are outside and looking in upon a process. Such onlookers have the advantage of perspective free from the possible confusion of details, but their lack of knowledge of details and the interrelations of details may lead them to a very wrong interpretation of the process as a whole. In this case let us consider the present-day interpretation of science and scientific research by philosophers. As a basis for the discussion we cite three recent philosophical books written severally by Hutchins, Durant and Benjamin.

The speaker gets the impression from these books that scientists are random or aimless collectors of data. In Section 7 of this paper we have discussed the use of hypotheses in scientific research and emphasized the fact that the use of hypotheses makes every step of research purposeful and directive. Philosophers certainly could not get the idea that research is an aimless collecting of data by studying research as it is conducted to-day. Where did they get this idea? Their descriptions of the scientific method are very similar to research methods outlined by Francis Bacon during the early part of the seventeenth century. It is granted that Francis Bacon was one of the world's greatest minds with his tremendous scope of knowledge and profound and accurate thinking; it is also true that he had little insight into the great complexity and profundity to be met in scientific problems and little realization of the methods that were to prove most effective in solving these problems. Is it too much to ask of philosophers that they evaluate the scientific research on the basis of a careful study of what is going on in science to-day?

President Hutchins speaks with devastating effect of scientific knowledge as empirical knowledge. We find two definitions of empirical in the dictionary; one derogatory, the other complimentary. In the first sense it means superficial or based on insufficient observations, and in the second or the derived sense it means based on experience or experiments. If one stops to think, he will see that all real knowledge, *i.e.*, knowledge that has its counterpart in mind and matter, must be knowledge gained by experience or experiments. The scientist might even boast of his knowledge as empirical in the latter sense.

From reading these books one also gets the idea that scientists fail dismally to correlate their results into a logical system of thought. To a degree this has been true in botany during the period of great specialization through which the subject has passed recently. Fearing the ills of specialization Hutchins has suggested a common college course for all students so that when they get into their special fields they may have common knowledge as a basis for mutual understanding. This gives one a picture of confusion of tongues brought about by specialization. To one working in the field of botanical research to-day this idea of the confusion of tongues due to specialization appears far from an actual picture of the situation. Not only is every research man interested in and conversant with the results being obtained in many other phases of botanical research, but many problems are being investigated cooperatively by two or more specialists of diverse training combining the technics and knowledge of disciplines necessary for solving the problems. As botanical research advances larger generalizations are reached which in turn solve more practical plant problems and throw more light on the nature of life itself.

These philosophical writings give one the impression that the scientific mind shows certain immaturity as against the maturity of the philosophical mind. The botanist writes his story of plants as far as he can on the basis of established facts and laws; he struggles to add to known laws and facts about plants so that the true story may be continued; but he always recognizes that the complete story can be written, if ever, only after an enormous amount of additional research. The philosopher seems to demand the complete story, although most of it is a fairy tale.

One gets the impression from these philosophical writings that the main interest of scientists is improving practice. It is now rather generally conceded not only by scientists but by thinking practical men that the quickest and surest way of solving practical problems is to establish basic principles that underlie practical problems.

Then may I say in closing that the main aim of botany of the future is not the development of better methods for plant production and utilization of plant products, for these will come as an inevitable result if the study is rightly conducted. The main aim is the formulation of a system of knowledge of plants based on experimentally established facts—if you please, a factual philosophy of plant life.

OBITUARY

RAEMER REX RENSHAW

THE death of Dr. Raemer Rex Renshaw on September 23 in New York City saddened his many friends and colleagues. As senior professor of organic chemistry at New York University since 1924, he was well known and respected for his personal and intellectual qualities. His passing came as a sad loss to his university and to American chemistry.

Raemer Rex Renshaw was born in Sierraville, California, on August 31, 1880. In 1902 he was graduated from the University of Oregon with the bachelor of science degree. He received his master of science degree from the same institution the following year, while holding the position of instructor. In 1904 he left Oregon to become university fellow at Columbia University, and later was granted the degree of doctor of philosophy by that university, in 1907.

After completing the work for his doctor's degree he continued his career of service to American chemical education with professorships successively at Wesleyan University, Iowa State College, Harvard University and, since 1920, at the chemistry department of New York University at University Heights in New York City.

During the world war, Dr. Renshaw held the rank of captain in the Chemical Warfare Service. He was active in the work of scientific societies as chairman of the Organic Division of the American Chemical Society in 1924, chairman of the New York Section in 1929, and secretary of the Chemistry Section of the American Association for the Advancement of Science during the period 1929–1931.

His researches were reported in a large number of publications and covered, among others, the following topics: Aminophthalic acids; lecithins; cholin and betaine and their sulfur, arsenic and phosphorus analogues; diglycerids; trimethylarsine selenid; carbohydrates; dyes containing the furane ring; onium compounds; acetylcholin and its physiological functions.

Dr. Renshaw's patient understanding of students, his inspiring encouragement of his younger associates and his general kindliness will long be remembered by those who knew him.

H. G. LINDWALL

NEW YORK UNIVERSITY

JOHN ORR HAMILTON

PROFESSOR JOHN ORR HAMILTON, for twenty-nine years head of the department of physics in the Kansas State College of Agriculture and Applied Science, died on August 9, 1938, from an attack of angina pectoris. Though he had been relieved in part from institutional responsibility, his death came as a sudden shock to a host of friends among the faculty, students and alumni.

Professor Hamilton was born at Princeton, Indiana, on September 4, 1867. Following teaching experience and study elsewhere, he was in 1900 graduated from the University of Chicago, having given special attention to mathematics and physics. He was first connected with the Kansas State College in 1901, going there as assistant in physics. For several years the department included electrical engineering, and Professor Hamilton's interest was always strong in the everyday application of physics to industry, including agriculture and the household. He was the author of a text on "Physics of the Household," a "Laboratory Manual for Engineering Physics" and "Weather Studies."

In 1912 radio station 9YV was licensed, and the physics department began a daily broadcast of the weather reports. This was in Morse code and available to any who could read it, and is believed to have been the first regular radio weather service inaugurated. During the world war, Professor Hamilton directed the training of men in signal service work.

Professor Hamilton was an excellent teacher and upheld the highest educational and ethical standards in respect to teacher effort and student response. His interest in young men was manifested by his fostering attitude toward college athletics. He was the faculty representative in college athletic conferences and chairman of the Athletic Board. He supported the highest standards of intercollegiate athletics and regarded games as sports rather than business enterprises.

Contacts with students in their academic, athletic, financial and organized capacities gave Professor Hamilton keen insight into and sympathy with their various institutional activities, and he was highly esteemed by students as well as the faculty. In a final substantial act he showed his interest in them by leaving a bequest of $6,000 for the student loan fund.

J. T. WILLARD

KANSAS STATE COLLEGE,
MANHATTAN

RECENT DEATHS AND MEMORIALS

J. E. OSTRANDER, from 1897 to 1928 professor of mathematics and civil engineering at the Massachusetts State College at Amherst, died on October 19 at the age of seventy-three years.

DR. JOHN ROBERTS CAULK, professor of clinical genito-urinary surgery since 1914 at the School of Medicine of Washington University, St. Louis, died on October 13 at the age of fifty-six years.

THE first of a series of six paintings of pioneers of American medicine, to be prepared for the American College of Surgeons, shows the surgeon Dr. William Beaumont with Alexis St. Martin, half-breed trapper, who was the subject of his study of the digestive process. Other pictures, all painted by Dean Cornwell, of New York, will show Ephraim McDowell, who performed the first successful abdominal ovarian operation; Dorothea Lynde Dix, crusader for good treatment of the feeble-minded and insane; Dr. Oliver Wendell Holmes, pioneer in combatting puerperal fever; Crawford W. Long and William Thomas Greene Morton, pioneers of anesthesia, and Major Walter Reed, conqueror of yellow fever. It is planned to exhibit the paintings at medical centers throughout the country.

SCIENTIFIC EVENTS

THE SALMON FISHERIES OF FRASER RIVER

THE International Pacific Salmon Fisheries Commission, established under the treaty of 1937 between the United States and Canada to regulate the sockeye salmon fisheries of the Fraser River, has now under way a program of scientific investigations, with headquarters at New Westminster, B. C.

Its staff has designed and is using a tag to mark migrating sockeye salmon, which will be of interest to the many who use such tags to study the biology of fish. It is similar in form and attachment to that used in striped bass investigations by Merriman and by others. Two celluloid discs are used, held on opposite sides of the back of the fish by a nickel pin run through the firm tissue below the last rays of the dorsal fin. One disc has a number and the address of the commission printed on the side next the fish. The discs differ from previous tags in their color and eye-like pattern, adapted as shown by experiments to be most readily seen under the conditions met by migrating salmon. A white circular tag, 13.5 mm in diameter, has a central round red spot 7 mm in diameter. The white contrasts with the red color of the spawning sockeye, the red in a white field with its silvery condition as it approaches the river. The pattern attracts attention of observers quickly, and can be seen after the fish itself has been lost to sight. It should be plainly visible on the spawning grounds.

The use of both pattern and color seems to be fortunate, judging by its initial success. Returns have been unusually high, over 50 per cent. of the first lot of thirty having been returned within three weeks, prior to the beginning of the heavy fishery. The forthcoming survey of the spawning grounds should recover more.

This tag is designed to do two things. One is to follow the course of the fish through the commercial catch and to connect the particular "run" of fish tagged with its particular spawning grounds. As far as known, no intensive work to this end has been done on Pacific salmon. The second is to determine the percentage of fish which escape the commercial catch and reach the spawning grounds. In other words, to determine the population on the spawning grounds.

This is not a new method of estimating populations, other investigators on other species having proposed it for use in lakes, etc., and its use is common in marine investigations to show the "intensity" of a fishery.

In the present instance it follows an attempt, over many years, by officers of the Canadian Department of Fisheries to estimate the escapement to particular spawning grounds. The use of tags may, if successful, make such estimates more accurate. If, for example, a thousand tagged salmon are released on a spawning ground, and only five hundred are visible, any count of untagged fish must be correspondingly multiplied. The count of all fish must then be multiplied by two to give an approximation to the numbers of fish actually present. It is hoped to check such approximations by counting all fish over a weir, where such can be built.

If it proves possible to segregate the run of sockeye salmon of a given race in the commercial catch and if the proportion escaping to spawn may by this or similar methods be determined, the total numbers of salmon in the particular run of that race could be known. Naturally, this ideal will be difficult of attainment, first because of the confusion of races in the commercial areas, and second, because the proposed, as well as other, methods of estimating the escapement are still unproved. The goal, a separation of the several distinct strains or races of salmon and a knowledge of the fluctuation in numbers of each, is the same as that which in modern fisheries science is recognized as indispensable to regulation, a statistical history of the relation of yield to reproduction.

The tag and its application have been developed by a staff consisting of W. F. Thompson, R. E. Foerster, W. E. Ricker, J. L. Kask, C. E. Atkinson and L. E. Whitesel.

A NEW OBSERVATORY TO STUDY THE SUN'S RADIATION

On a mountain top in New Mexico in one of the driest, clearest spots in the United States, the Smithsonian Institution is now setting up a new observatory to observe the daily variations in the radiation of the sun.

At this observatory will be installed the apparatus used by Smithsonian observers at the observatory on the summit of Mt. St. Katharine on the Sinai Peninsula, which was closed last year. In many respects an ideal site for eastern hemisphere observations of solar radiation, the isolation of the spot and the extremely forbidding environment led the institution to close it after a very successful record of four years.

Alfred F. Moore, who had been in charge of the Mt. St. Katherine station, returned to the United States this spring and almost immediately, under the direction of Secretary Charles G. Abbot, started his search for a suitable American station. The ideal spot is one in which there is a minimum of cloudiness and rainfall, together with a very clear atmosphere usually to be attained only at great heights.

Mr. Moore found an excellent combination of these conditions on the 8,000-feet-high peak of Burro Mountain near the village of Tyrone in extreme southwestern New Mexico. Meteorological records show that this site has approximately 10 inches of rainfall a year. This in itself is small, but there is the additional advantage that it is nearly all concentrated in the months of July, August and September. A cloudy day is an extreme rarity at any other season. In contrast to most of the stations occupied by the Smithsonian Astrophysical Observatory, this is a very pleasant spot, according to Secretary Abbot, who has just returned to Washington after inspecting the progress of the work. There are small trees, shrubbery and flowers on the mountain top. There is an excellent source of water only two miles away, and it is planned to build a large reservoir tank on the summit itself.

The observing instruments, including some of the most delicate and sensitive known to astronomy, will be located in a horizontal tunnel extending back for approximately 30 feet into the mountain. The sunlight will be reflected into this tunnel and upon the measuring instruments by a mirror. The excavation of this tunnel is now completed. Living quarters are being built for the observers and their families.

The work of the observatory, in common with that of the other Smithsonian astrophysical stations, will be to determine daily variations from the solar constant—the average amount to which a black body one cubic centimeter in dimensions would be heated by the rays of the sun falling upon it in a minute, providing it were located at the mean solar distance and at the outer limits of the earth's atmosphere. In actual practice, of course, no such direct measurement can be made, but the same result can be obtained with the use of extraordinarily delicate measuring devices when proper allowance is made for the effect of various thicknesses of atmosphere on sunlight passing through it.

The Smithsonian Institution has gathered a large number of such daily records. They show clearly that the heat and light output of the sun is constantly fluctuating and that these fluctuations follow periodic curves. There is reason to believe that these fluctuations, in turn, are a major element in the fluctuations of temperature and precipitation on earth. The subject, however, is complicated and constant observations, together with a constant effort to make them more and more accurate, are essential.

SCIENTIFIC LECTURES OF THE COLLEGE OF PHYSICIANS OF PHILADELPHIA

The program for evening scientific lectures of the College of Physicians of Philadelphia for 1938–1939 is as follows:

October 12.—James M. Anders Lecture XIII. Homer F. Swift and Alfred E. Cohn, members of the Rockefeller Institute for Medical Research. "Cardiac Diseases: Infectious and Non-Infectious, Course and Consequences."

November 2.—Edward A. Strecker, professor of psychiatry, University of Pennsylvania. "Should Psychoanalysis Be Purged?"

December 7.—Thomas Dent Mütter Lecture LI. William Boyd, professor of pathology and bacteriology, University of Toronto; pathologist, Toronto General Hospital. "Some Reasons for the Recent Increase in Bronchial Carcinoma."

January 4.—Nathan Lewis Hatfield Lecture XXI. Walter Bauer, associate professor and tutor in medicine, Harvard Medical School; physician, Massachusetts General Hospital, Boston. "Studies Pertaining to the Origin and Nature of Hypertrophic Arthritis."

February 1.—Nathan Lewis Hatfield Lecture XXII. C. N. H. Long, Sterling professor of physiological chemistry, Yale University. "Diabetes Mellitus in the Light of Our Present Knowledge of Metabolism."

March 1.—Mary Scott Newbold Lecture XLII. W. B. Castle, professor of medicine, Harvard Medical School; associate director, Thorndike Memorial Laboratory, Boston City Hospital. "The Diagnosis and Treatment of Anemia."

April 5.—Claude S. Beck, associate professor of surgery, Western Reserve University; associate surgeon, University Hospitals, Cleveland. "The Surgical Approach to Diseases of the Heart."

May 3.—Mary Scott Newbold Lecture XLIII. William J. Kerr, professor of medicine, University of California; physician-in-chief, University Hospital, San Francisco. "A New Approach to the Etiology and Treatment of Angina Pectoris."

LECTURES FOR THE GENERAL PUBLIC

November 18.—Alfred Stengel, vice-president in charge of medical affairs, University of Pennsylvania. "Currents and Counter-Currents in the Progress of Medicine."

January 20.—George P. Muller, professor of surgery, Jefferson Medical College. "Surgical Trends and Medical Progress."

April 14.—Earl D. Bond, professor of psychiatry, University of Pennsylvania; director, Institute for Mental Hygiene, Pennsylvania Hospital. "The Modern Interpretation of Mental Disorders."

NOMINATIONS FOR THE PRESIDENCY OF THE AMERICAN CHEMICAL SOCIETY

Dr. Charles L. Parsons, secretary of the American Chemical Society, has announced the nomination of fourteen candidates for the presidency of the society. The nominations are made by the local sections and they will be voted upon in a pool of the 23,000 members of the society. The names of the four members receiving the largest number of votes will be brought before the council for election.

The president-elect of the society will take office on January 1, 1939, and will become president a year later. Professor Charles A. Kraus, of Brown University, now president-elect, will be president during 1939, succeeding Dean Frank C. Whitmore, of Pennsylvania State College.

The list of candidates follows:

Erle M. Billings, business and technical personnel director of the Eastman Kodak Company, Rochester, N. Y.

Professor H. S. Booth, of Western Reserve University, Cleveland, Ohio.

Gustav Egloff, director of research of the Universal Oil Products Company, Chicago.

Gustavus J. Esselen, president of Gustavus J. Esselen, Inc., Boston.

Francis C. Frary, director of research of the Aluminum Company of America, New Kensington, Pa.

Per K. Frolich, director of the Chemical Laboratories of the Standard Oil Development Company, Elizabeth, N. J.

Professor Harrison Hale, of the University of Arkansas.

Professor W. D. Harkins, of the University of Chicago.

Professor Samuel C. Lind, dean of the Institute of Technology of the University of Minnesota.

E. Emmet Reid, emeritus professor of chemistry, the Johns Hopkins University.

Walter A. Schmidt, president and general manager of the Western Precipitation Company, Los Angeles.

Professor Hugh S. Taylor, of Princeton University.

Ernest H. Volwiler, vice-president of Abbott Laboratories, Chicago.

Professor Hobart H. Willard, of the University of Michigan.

SCIENTIFIC NOTES AND NEWS

The John Fritz Gold Medal has been awarded to Dr. Frank Baldwin Jewett, vice-president of the American Telephone and Telegraph Company and president of the Bell Telephone Laboratories, for "vision and leadership in science and for notable achievement in the furtherance of industrial research and development in communication." The award is made by a committee composed of representatives of the American Society of Civil Engineers, the American Institute of Mining and Metallurgical Engineers, the American Society of Mechanical Engineers and the American Institute of Electrical Engineers.

Louis Shattuck Cates, president of the Phelps Dodge Corporation, was elected William Lawrence Saunders gold medallist at a meeting on October 17 of the board of directors of the American Institute of Mining and Metallurgical Engineers.

Dr. John Van Nostrand Dorr, president of the Dorr Company, Incorporated, will be presented with the Medal of the Society of Chemical Industry on November 4, at a joint meeting of the American Section of the Society of Chemical Industry and of the American Chemical Society, at the Chemists' Club, New York City. The medal is given for "valuable application of chemical research to industry," and was awarded to Dr. Dorr for his inventions that have permitted large-scale, low-cost operations in many chemical, metallurgical and sanitational operations.

It is reported in *Nature* that Professor B. W. Holman, assistant professor of mining in the Imperial College of Science and Technology, has been awarded the Gold Medal of the National Bureau of Scientific and Industrial Research by the French Minister of Instruction and Fine Arts.

The doctorate of laws was conferred by Lafayette College at the annual Founders Day celebration on Dr. Gilbert H. Grosvenor, president of the National Geographic Society.

Among the honorary degrees conferred by Loyola College, Baltimore, on the occasion of the installation on October 20 of the Rev. Edward B. Bunn, S.J., as president of the college, was the doctorate of laws on Dr. John Charles Hubbard, professor of physics at the Johns Hopkins University.

Dr. Leonard Carmichael, from 1928 to 1936 professor of psychology at the University of Rochester, will be installed as president of Tufts College on November 4. Dr. James B. Conant, president of Harvard University, will be a speaker at the luncheon following the ceremony.

At the meeting of the fifth International Congress for Experimental Cytology, which was held at Zürich from August 7 to 13, Dr. Warren H. Lewis, of the department of embryology of the Carnegie Institution of Washington and the Johns Hopkins Medical School, was elected president. Dr. Harald Okkels, of the department of anatomy of the University of Copenhagen, was reelected secretary. The next congress will be held in Stockholm in August, 1940, with Dr. Runnström, of Stockholm, as local president in charge of the program.

Dr. André Crotti, of Columbus, Ohio, was elected president of the International Congress of Surgeons at the Philadelphia meeting. Dr. Fred M. Douglas, of Toledo, Ohio, was elected president of the United States Chapter.

A life-sized portrait of Dr. T. U. Taylor, for more than forty years dean of the College of Engineering at the University of Texas, has been presented to the college by his former students. The portrait, painted in oils by Mrs. Mary Talbot Landrum, will hang in the Engineering Building.

Dr. John T. Buchholz, professor of botany at the University of Illinois, has been appointed head of the department to succeed Dr. Charles F. Hottes, who retired with the title emeritus at the close of the academic year. A banquet, attended by 125 of his colleagues, friends and former students, was given in honor of Dr. Hottes, and a portrait painted by Miriam Buchholz was unveiled and hung in the reading room of the Natural History Library.

Dr. John W. Roy Norton, assistant director of preventive medicine of the North Carolina State Board of Health, has been appointed professor of public health administration in the division of public health of the School of Medicine of the University of North Carolina.

Dr. Hiram Bentley Glass, of Stephens College, Columbia, Mo., has been appointed assistant professor of biology at Goucher College. Dr. Harriette Dryden Vera has been appointed instructor in physiology and hygiene.

Dr. Herbert C. Hanson has become director of the North Dakota Experiment Station. Other appointments include Darlene M. Knowles, home economics specialist, to conduct research in nutrition problems and rural and urban family life and to direct studies on home-making; and Stanley Saugstad, assistant in entomology, to assist in field studies relative to the life cycle and control of insects and wild life.

Dr. J. Holmes Martin, professor of poultry husbandry and genetics at the University of Kentucky, has been made director of the new Regional Poultry Research Laboratory of the U. S. Department of Agriculture at East Lansing, Mich. He will take up the work on January 1.

Dr. Lloyd C. Fogg, assistant professor of zoology at the University of New Hampshire, will become director of the zoological laboratory on the Isle of Shoals when its twelfth session opens next June. He succeeds Dr. C. Floyd Jackson, professor of zoology and entomology and dean of the College of Liberal Arts, who has resigned as director.

Nature reports that on advice furnished by the general officers of the British Association the scientific representatives on the Scientific Advisory Committee of the Trades Union will be: Nutrition and agriculture, Sir Daniel Hall and Sir John Orr; physics, Professor Allan Ferguson and Professor P. M. S. Blackett; chemistry, Professor F. G. Donnan and Professor A. C. G. Egerton; physiology and psychology, Professor Winifred Cullis; population, Professor L. Hogben; metallurgy, Professor J. D. Bernal; geology and geography, Professor P. G. H. Boswell; engineering, J. S. Wilson.

William G. Cochran, mathematical statistician of the Rothamsted Experimental Station, arrived at Ames, Iowa, on October 17 to work with the Statistical Laboratory for two months under a cooperative agreement between the Iowa State College and the U. S. Department of Agriculture.

Professors Carl J. Drake and C. H. Richardson, of the department of zoology of the Iowa State College, left for Argentina on October 21. At the invitation of the Agricultural Society of Argentina, they will make a study of grasshopper and locust problems, and the application there of control measures being used in the United States.

Dr. John F. Fulton, Sterling professor of physiology in the School of Medicine of Yale University, spoke on October 20 at a meeting of the university chapter of the Society of Sigma Xi. His subject was the history of oxygen with particular reference to Robert Boyle, John Mayow and Joseph Priestley.

Dr. W. J. Humphreys, collaborator of the U. S. Weather Bureau and emeritus professor of physics at the George Washington University, gave on October 14 an address entitled "Sky Splendors and Sky Puzzles" before the Rittenhouse Astronomical Society of Philadelphia.

Dr. George Howard Parker, professor emeritus of zoology, formerly director of the Harvard Zoological Laboratories, lectured on October 19 before the American Academy of Arts and Sciences, Boston. His subject was: "Modern Views on the Action of the Nervous System as Illustrated by the Color Changes of Animals."

At the annual meeting of the Association of American Medical Colleges, which opened at Syracuse on October 24, the presidential address was given by Dr. Alan M. Chesney, dean of the School of Medicine of the Johns Hopkins University. Among the principal speakers was Dr. Thomas Parran, Jr., surgeon general of the United States, whose address was entitled "The Future of the Public Health Movement." The opening session included a symposium on the place of preventive medicine in the medical curriculum.

At the New York meeting of the clinical congress of the American College of Surgeons, the fourth annual oration on surgery, delivered by Dr. Walter W. Chipman, professor emeritus of the McGill University Medical College, was a tribute to Dr. Allen B. Kanavel, a founder and former president of the college.

The Section for Psychology of the American Association for the Advancement of Science will meet in Richmond, Va., from Tuesday, December 27, to Thursday, December 29. In addition to the usual program of contributed papers there will be, on Wednesday, December 28, a symposium on "Recent Advances in the Psychology and Physiology of Audition," under the chairmanship of Dr. Elmer A. Culler, of the University of Rochester.

The eighth semi-annual meeting of the Eastern Photoelasticity Conference will be held on December 10 at Columbia University. A symposium on three-dimensional photoelasticity is planned for the technical sessions. Further information may be obtained by addressing R. D. Mindlin, Columbia University, New York City.

The first meeting of the newly organized Philadelphia Geological Society under the presidency of Professor Edward H. Watson, chairman of the department of geology at Bryn Mawr College, was held on October 20 in the library of the Academy of Natural Sciences. A short address by Charles M. B. Cadwalader, president of the academy, opened the meeting, and the principal speaker was Professor W. Berryman Scott, of Princeton University, who spoke on "Philadelphia as a Center of Vertebrate Paleontology Sixty Years Ago." This society has grown from small informal meetings at the University of Pennsylvania, which were instituted in 1934 by Dr. A. Williams Postel, of the department of geology. Plans for the expansion of the society were drawn up last spring by a committee under the chairmanship of Dr. B. F. Howell, of the department of geology and paleontology of the Academy of Natural Sciences.

It is reported in *Nature* that the International Union against Cancer, which comprises ninety-two organizations representing fifty-two nations, has succeeded in arranging for an International Week against Cancer for November 23 to 30, which it is hoped will take place simultaneously in fifty countries. In connection with the celebrations, an international commemoration of the discovery of radium, electrons, x-rays and Hertzian waves will take place on November 23 at the Sorbonne. Papers will be presented by O. Hahn, Berlin-Dahlem; G. Hevesy, Copenhagen; G. P. Thomson, London; M. von Laue, Berlin; A. Sommerfeld, Munich; J. Errera, Brussels; F. Carter Wood, New York; J. D. Bernal, London; H. Stubbe, Berlin-Dahlem; A. Bouwers, Eindhoven, and L. Marton, Brussels, in addition to French men of science. Further particulars of the meeting can be obtained from the secretary-general of the Semaine Internationale contre le Cancer, 18 rue Soufflot, Paris (V).

The Medical College of Virginia, Richmond, has received from the estate of the late Bettie Davis Wood securities valued at slightly more than a million dollars. This will be added to the endowment funds of the institution and used for general purposes. The bequest will be known as the Judd B. Wood and Bettie Davis Wood Memorial, named for the late Dr. Wood, who was a dentist of Richmond, and his wife, who together provided the bequest.

Plans for the first building for the Institute for Advanced Study at Princeton have been approved by the board of trustees. At present members of the institute use the buildings and facilities of Princeton University. While relations with the faculty and advanced scholars of the university will continue, the new hall will provide a center of activity for its now scattered students. It will be known as Fuld Hall, in honor of Felix Fuld, whose wife was one of the original founders of the institute. Construction will begin immediately and it is hoped that it will be ready for occupancy by the middle of September, 1939. The hall, which will be erected at the cost of $500,000, will be constructed of colonial and Georgian brick. It will be approximately 250 feet in length, and will be situated on the Olden farm, a tract of about 450 acres adjoining the Graduate College of Princeton University. There will be studies for members of the professorial staff and students, in addition to seminar rooms, a library, a commons and a lounging room.

THE cornerstone for the new building of the New York Medical College, Flower and Fifth Avenue Hospitals was laid on October 20. This date is the fiftieth anniversary of the laying of the cornerstone of the old buildings at 64th Street and is eighty years since the founding of the institution by William Cullen Bryant. The new building is located between 105th and 106th Streets on Fifth Avenue. It is expected to be completed for occupancy by June, 1939. A special program given in the afternoon included speeches by Dr. George W. Crile and Mayor Fiorello H. La Guardia. The new building will house all the departments of the college as well as the out-patient department of the hospitals.

A DIVISION OF AGRICULTURAL AND INDUSTRIAL MARKETING was recently set up by the Oregon State Board of Higher Education, its purpose being "to increase the wealth and income of the people of Oregon by encouraging the use of scientific methods in marketing Oregon products." A committee has been appointed by the board to advise with the director of the new division on all important matters of policy and procedure. The term of service of members will be nine years, one member to be appointed each year. The nomination of a director will be made by a committee consisting of Dr. Frederick M. Hunter, chancellor of the Oregon State System of Higher Education, President Donald M. Erb, of the University of Oregon, and President George W. Peavy, of the Oregon State College.

DISCUSSION

NUCLEAR CONTROL OF CELL ACTIVITY

THE changes that take place during development resulting from the loss or shift of chromosomes or chromosome segments have a direct bearing on the control of growth. Stern has pointed out recently[1] that single cell mosaics indicate a regulation of characters expressed in the cytoplasm by the nucleus, evidently by means of diffusible substances that pass through the nuclear membrane, since there is no subsequent cell division and consequently no disappearance of the nuclear membrane.

In maize seeds single cell mosaics exhibit changes in color, in starch formation and in size and shape of cells. Color in the aleurone cell is expressed in pigmented granules in the cytoplasm. The nucleus is colorless. Starch is likewise laid down in the cytoplasm and may vary from the normal blue-staining starch to the red-staining erythrodextrin, to the brown-staining sugary condition or to colorless. Changes in size of aleurone cells range from twice the diameter of normal cells up to ten times normal size or even more. Shape also varies widely from the normal spherical condition.

All these changes occur in single cells which appear alone or paired with other cells showing different alterations from normal. The effect of lethal conditions is also manifested in single cells. Lindegren and Scott[2] illustrate an ascus in Neurospora with four of the eight ascospores aborted. These aborted and normal cells are arranged in such an order that the lethal action did not stop cell division until the second equational division had taken place. This is an apparent exception to the direct action of diffusible substances, since the lethal effect was delayed until after one cell division.

The evidence derived from genetic and cytological observations shows that changes originate in aberrant chromosome behavior. The exact nature of this aberration is not known in every case, but the final result of these nuclear changes is expressed in the cytoplasm. Since in the single cell mosaics no cell division has taken place following the first alteration in nuclear constitution, the changes in cell size, shape and composition are apparently due to some influence originating in the nucleus and passing through the nuclear membrane.

External agents, which may be physical, chemical or biological, can initiate changes in cell activity. They are either similar in their action to substances originating in the nucleus or they act upon the nuclear material in such a way as to bring about the production of more or less of the same substances. Since these induced growth alterations are sometimes permanent, in that they can be propagated indefinitely by tissue transplantation it would seem more likely that the effect of external agents is an indirect one, first altering the nuclear constitutents. These in turn have their effect in the usual way. This seems probable in view of the fact that many heritable growth variations are similar to the induced changes and these naturally arising variations can be recombined with other heritable characters whose determiners are known to be located on the chromosomes.

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[1] *Amer. Nat.*, 72: 350, 1938.

[2] *La Cellule*, 45: 361, 1937.

DONALD F. JONES
CONNECTICUT AGRICULTURAL EXPERIMENT
STATION, NEW HAVEN

MEASUREMENTS OF FOREST FIRE DANGER

ALTHOUGH the annual destruction of life and property attributable to forest fires is enormous, scientific methods of forest fire control in the United States are of comparatively recent origin. In one important phase of control, that of determining how large a network of observers is necessary for the purpose of discovering forest fires in their infancy, accurate means of determination have been largely lacking. As a result of this uncertainty, lookout points have been excessively manned in some years, thus introducing unnecessary costs, and under-manned in other years, resulting in excessive fire damage.

The problem presented here is actually one of determining the burning conditions in the forest, *i.e.*, the relative ease with which fires will start, spread and do damage. Fire danger, as the sum of these conditions is termed, has interested research foresters for several years. Beginning fire danger measurements in 1922, the Northern Rocky Mountain Forest and Range Experiment Station of the U. S. Forest Service has recently devised a method which is achieving considerable success in the field. This method depends upon a knowledge of the important factors contributing to fire danger, methods of measuring these factors and integration of measurements into single numerical results.

Important factors contributing to fire danger vary from one forest region to another, but in the northern Rocky Mountains these factors have been determined. They are:

(1) *Season of year:* In spring and early summer the green moist growth of herbaceous plants and shrubs actually hinders the progress of fires. Later, as these plants mature, they accelerate forest fire spread and intensity. At the same time hours of daily sunshine decrease with advancing season, and finally this latter process largely offsets the increased danger from maturing plants.

(2) *Fuel moisture:* The moisture content of tree needles on the forest floor and dead branchwood on the ground and just above it is largely dependent upon meteorological conditions. Its influence upon inception of fires and later behavior is considerable.

(3) *Relative humidity:* The moisture content of all forest fuels is influenced by atmospheric humidity. This relationship is especially important in the case of fine forest fuels such as tree moss, dead grass and weeds.

(4) *Wind velocity:* Rate of spread and the character of an advancing fire, as well as the rate at which forest fuels lose moisture, are dependent to a considerable degree upon wind velocity.

(5) *Visibility:* The distance at which small puffs of smoke can be detected under various stages of atmospheric transparency influences the number of lookout points that must be manned under any set of fire conditions.

(6) *Activity of fire-starting agencies:* In the northern Rocky Mountains lightning causes 72 per cent. of the forest fires. Man is a subordinate cause, although in other regions he may be of paramount importance.

To measure wind velocity and relative humidity, standard types of anemometers and psychrometers are used. For measuring fuel moisture and visibility, however, new methods had to be devised. A visibility meter, employing a glass prism and binoculars, permits a determination of the distance at which a dark ridge can barely be seen. Since this bears a definite relationship to the distance at which a small puff of smoke can be seen, a visibility distance useful to the fire observer is calculated. Two methods are used for fuel moisture determinations. An instrument called the duff hygrometer measures moisture content of forest duff; it depends upon the principle that a strip of rattan increases in length by definite amounts as it absorbs water and decreases in length by corresponding amounts as it dries. The second method is simply a weight determination of cylinders of wood; the fluctuations in weight are indications of fluctuations in moisture content.

For integrating measurements into numerical results, the fire danger meter has been employed. This is a pocket-size cardboard device somewhat similar to the Harvey exposure meter used in photography. The meter is easily adjusted to register whatever measurements of fire danger factors have been obtained. Through a small window in the meter, current fire danger is indicated. Until this year only seven classes of danger were used, but at the beginning of the present fire season, 65 classes of danger went into effect, ranging from 1.0 to 7.4.

Each class of forest fire danger indicates how many observers are necessary to provide adequate protection to the forests. Class 1 requires no men to be detailed to fire control; class 4 requires the "average season" protective organization; class 7 calls for measures to meet the most extreme danger.

So successful is the system of classifying fire danger in the forests of the northern Rocky Mountains that all national forest regions have been instructed to develop similar methods of measuring fire danger.

Leo Shames

FILMY FERNS IN THE CAROLINAS

No species of the interesting and peculiar group of ferns known as the filmy ferns (Hymenophyllaceae) has ever been found in the Atlantic States north of Georgia. We can now report the occurrence of three of them in the Carolinas, one new to the North American continent. They are: *Hymenophyllum tunbridgense* (L.) J. E. Smith and *Trichomanes Petersii* A. Gray from Pickens County, northwestern South Carolina, and *Trichomanes Boschianum* Sturm from Macon County, southwestern North Carolina. The former is new to North America. The station for *T. Boschianum* near Highlands, N. C., was discovered by Dr. Herbert Hechenbleikner, who was working at the Highlands Laboratory with W. C. Coker. The two South Carolina plants were found by Mrs. Bayard Taylor several years ago. With her and Dr. Taylor, W. C. Coker visited the stations on October 9 of this year and found populous colonies of both of them. All three species were found on granitic gneiss, not on sandstone, as was to be expected.

Mary S. Taylor
W. C. Coker

University of North Carolina

THE WOODS HOLE MARINE BIOLOGICAL LABORATORY

Biologists are reminded that one of the sources of income upon which the Marine Biological Laboratory depends for its maintenance is the sale of biological materials by its supply department to educational and scientific institutions.

In spite of the extensive damage to laboratory property caused by the recent storm, the supply department is prepared to fill orders promptly. It will appreciate at this time the opportunity of serving the members of the corporation and other biologists.

By placing your orders for material with the supply department you will, in a substantial way, help the laboratory to repair its very considerable losses.

The damage to the buildings of the Marine Biological Laboratory, caused by the storm of September 21, was almost wholly due to water. The tide in Buzzards Bay rose about 10 feet above the normal high water mark, overflowed the Eel Pond, poured into the supply department building through the windows and doors, and filled the basement of the brick building to a depth of 4 feet. Before the flood abated it had put out of commission the great storage battery and the switchboard, covered microscopes and other apparatus with mud, leaked into many stocks of chemicals, and had ruined cabinets and drawers where much small scientific material was stored. The loss to the supply department was fortunately not large.

Due to the unremitting efforts of those in charge of the various departments, the damage was kept at a minimum. But extensive repairs and replacements will be necessary. This work is already under way. It is confidently expected that the laboratory will soon be completely restored, and that research and instruction will be carried on as usual during the summer of 1939.

Charles Packard,
Associate Director

SCIENTIFIC BOOKS

LIGHT

Light. Principles and Experiments. By George S. Monk. Pp. xi + 477, figs. 265. McGraw-Hill Book Company, New York, 1937. Price, $5.00.

This text-book gives a combined treatment of three branches of optics which are too frequently separated, namely, geometrical optics, physical optics and laboratory work in both these fields. The first quarter contains a very good summary of geometrical optics: thick lenses, optical instruments, apertures, photometric principles and prism instruments. The principal section on physical optics contains chapters dealing with spectra, optical properties of media, effects of electric and magnetic fields, as well as the usual topics of interference, diffraction and polarization.

It is a pleasure to see that some spectroscopy is included, as this is one of the most important parts of applied optics. Additional experiments might have been outlined, such as those dealing with some of the uses of the quartz spectrograph and infra-red spectrometer. Such work would give valuable experience to the student, especially to one who is majoring in physics or chemistry. In order to provide a better background for such work, it would be advisable to give even more material on spectroscopic theory and nomenclature. In passing it might be noted that the author makes the mistake of saying that Rydberg's constant varies as the square of the atomic number of the element, whereas perhaps the most important contribution by Rydberg to spectroscopy is the demonstration that this constant is nearly the same for the arc spectra of all elements.

The diffraction grating could have been discussed more fully. The author considers that the theory is so involved that it obscures the final results. However, in this case the vibration polygon method, in which one adds the squares of the sums of the components of the amplitudes, is simple and applicable to many other diffraction problems as well. The diffraction pattern of a double slit and of a circular opening could have been simplified by the use of this method.

Too much is made of the fact that unpolarized light is not *actually* composed of the superposition of many linear component vibrations. Of course this is no more true than that the components of any force are really present in the force. It seems fruitless to discuss what is actually true in physical concepts. It is better to consider the extent to which the concept is useful, for example, that of rays in geometrical optics, waves in physical optics, wavelets in diffraction theory and photons in the quantum theory of light.

The introduction of an impossible cylindrical wave in the treatment of diffraction by a slit is certainly inconsistent with reality. As a matter of fact, one encounters here a two-dimensional integration over a plane or any other surface that one may choose. The integration in the direction of the length of the slit is carried out first and gives only a constant factor, while the integration across the slit leads to the characteristic result which is conveniently discussed with the aid of Fresnel integrals or Cornu's spiral.

In the chapter on double refraction it is stated that the double refraction of Cellophane is due to strains introduced in its manufacture. It should be more widely known that non-crystalline, strain-free materials are doubly refracting if they have a sub-microscopic structure, for example, fibrous or lamellar. Because of this fact, the polarizing microscope finds a useful application in the grading of cotton fibers, as well as in the study of the structures of various other plant and animal fibers and membranes.

The material in the chapter on color is not consistent with the best of modern practice in colorimetry, apparently because too much of it was taken from the older literature. The idea of desaturation by the addition of black is of no value in the measurement of color. The author makes reference to Hardy's excellent Handbook on Colorimetry, but does not use it to the fullest advantage.

The reviewer considers this to be the best book in its class, one for which there is a great need. In the intermediate optics laboratory it is desirable to include experiments in geometrical and physical optics and in spectroscopy without entirely losing sight of the underlying theory. This makes the field so broad that one has to select the subject-matter carefully, and it is not easy to satisfy a large number of teachers. Professor Monk has done very well indeed in this respect and has made a valuable contribution to optical literature.

Joseph Valasek

University of Minnesota

STATISTICAL AND MATHEMATICAL PHYSICS

Statistical Physics. By L. Landau and E. Lifshitz; translated from the Russian by D. Shoenberg. Pp. viii + 234, Oxford University Press, 1938.

This book presents the results of thermodynamics obtained by consideration of statistical methods. Instead of taking the first and second laws of thermodynamics as fundamental first principles, the thermodynamic relations are derived from the atomic properties of the systems concerned. Thus we have presented in a uniform manner two subjects which, although their intimate relationship has long been recognized, are usually divorced, and treated in separate text-books.

The authors confine themselves to those phenomena not connected with quantum effects. After a discussion of the fundamentals of statistics, they proceed to derive the usual thermodynamic functions and the gas laws. Then there are chapters devoted to chemical potentials and chemical reactions, phase equilibria and the properties of solutions. These are followed by a chapter on anisotropic bodies, which is based largely on original work of Landau. The book is completed by a discussion of surface phenomena, the whole forming a well-ordered and well-presented exposition.

No doubt the authors will be criticized for the statement in the preface, "no attempt has been made at mathematical rigor, since this is anyhow illusory in theoretical physics, but we have instead tried to make clear the fundamental physical assumptions on which the results are based." Nevertheless, the statement furnishes an excuse for such matters as the definition of probability as the limit of a ratio which approaches no limit in the rigorous mathematical sense and the omission of any discussion of the ergodic hypothesis. The clarity of the exposition as a whole, however, should largely condone such imperfections.

A more serious objection can be made to the complete lack of any numerical magnitudes of the quantities under discussion. Although there are examples interspersed throughout the text, they consist largely in the derivation of less important consequences of the theory. The comfortable feeling that one gets from knowing that the heat of vaporization at the boiling point is 539 calories per gram for water, but only 2.7 calories per gram for methyl alcohol is completely lacking. This, to be sure, is purely a matter of opinion, and the text could certainly be supplemented in such a way as to correct this, if it were desired. Altogether, the book is excellently done and would represent a valuable addition to any one's library.

Methoden der Mathematischen Physik. By R. Courant and D. Hilbert, Vol. II, pp. xvi + 549, Julius Springer, Berlin, 1937.

Physicists will welcome the second part of this most useful compilation. This volume deals with that part of the theory of partial differential equations which is important in relation to physics. The book is written primarily from a mathematician's point of view, developing the subject of partial differential equations in a systematic way, and then proceeding with the application of the theory to the problems of physics. Among the physical problems discussed are heat conduction; plane waves, Huyghens' principle and the optics of crystals; the Hamilton-Jacobi equation; the telegraph equation; and potential theory and hydrodynamics. There is also a valuable section devoted to Heaviside's method of operators.

The last chapter deals with boundary and *eigenwert* problems from the point of view of variational calculations. There is an indication that the mathematical methods discussed here will be of importance in the future perturbation calculations of the quantum theory. One wonders whether the present volume will have the almost prophetic nature of Volume I, which dealt extensively with *eigenwert* problems three years before the advent of wave mechanics.

Although, for the most part, the applications to physics are in rather neglected and unfashionable fields, the book should be in the reference libraries of all physical laboratories.

C. G. MONTGOMERY

BARTOL RESEARCH FOUNDATION OF
THE FRANKLIN INSTITUTE,
SWARTHMORE, PA.

THE CAMBRIDGE MEETING OF THE BRITISH ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE

THE British Association for the Advancement of Science this year held its annual meeting in Cambridge from August 17 to 24. This was the fifth time since its foundation that meetings of the association had been held in Cambridge, and the second time in the present century. The first Cambridge meeting was the third of the association, held under the presidency of the Reverend Adam Sedgwick in 1833. The association met again in Cambridge in 1845, when Sir John Herschel was president, and has since convened in 1862 under the presidency of the Reverend Professor Willis, and in 1904 under that of the Rt. Hon. A. J. Balfour.

Cambridge is in many ways a uniquely suitable setting for the association meetings. Situated as it is in the heart of the fen country, flanked by the chalk escarpment in the south and east, the western plateau south of Madingley along the Cambridge-Bedford road, and the fens in the north, it presents unique natural features of geographical and physiographical interest in addition to those of immense historical and more purely intellectual import for which it is more famous. It is likewise geographically extremely well centered for a great number of academic and industrial institutions of research and of learning in general, being especially readily accessible from the London and Oxford areas and reasonably convenient to the Midlands.

The inaugural meeting of the association was held on the evening of August 17, in the Regal Cinema, St. Andrews Street, at 8:00 P.M. This year's president of the association was the Rt. Hon. Lord Rayleigh, who had officiated as president of Section A in 1929. His address, entitled "Natural Vision and Vision Aided by Science," dealt with two rather sharply differentiated subjects—the extension of our sense of vision in the many ways which science has made possible and the degree of responsibility which the scientist must bear and the degree of censure from society as a whole to which he is justly subject, in connection with modern warfare. The address has appeared in SCIENCE for August 26 and September 2.

THE SECTIONAL MEETINGS

The association met, as usual, in thirteen sections, beginning on Thursday, August 18, and continuing throughout the time of the meeting.

The presidential address in Section A, given by Dr. G. C. Darwin in the Arts School on Friday, August 19, dealt with "Logic and Probability in Physics," part of which was printed in the issue of SCIENCE of August 19.

The sectional papers were characterized particularly by the symposium on nuclear physics, introduced by Niels Bohr, and to which contributions were made, among others, by Cockroft, Bothe, Dee and Feather. The central theme of the discussion was the Cavendish cyclotron and the uses to which it would be put, a study of excited states and of neutron-induced radioactivities in general. The mathematics portion of the section program was devoted very largely to a discussion of Newtonian root evaluations and a symposium on combinatorial mathematics in the design of experiments. A symposium on magnetic alloys and x-ray structure comprised the second major portion of the physics program, introduced by Bragg and participated in, among others, by Stoner, Bradley, Sucksmith and Oliver. Symposia on high-altitude cosmic radiation and low temperature physics, introduced respectively by Professor P. M. S. Blackett and Dr. H. G. B. Casimir, continued an unusually rich program, which was concluded by a symposium on seismology, introduced by Dr. F. J. W. Whipple.

The chemistry of gold was a principal theme of Section B (Chemistry) and was the subject of the presidential address of Professor Charles F. Gibson. Professor Gibson dealt particularly with the coordination numbers and covalency of aurous and auric gold. It was pointed out that while cuprous copper and argentous silver can exhibit 2- and 4-covalency, aurous gold is always 2-covalent, with the possible exceptions of the non-electrolytic complex aurous halides studied by Mann and his co-workers. Aurous gold shows an effective atomic number of 82. Auric gold is always coordinated and in its stable compounds always 4-covalent with a slight tendency to become 5-covalent. Gibson gave some account of original work in the preparation of dialkylhalogeno gold compounds, monoalkyldibromo complexes and cyano derivatives of organic gold compounds, and concluded with a discussion of the structure of gold compounds, with emphasis on the planar configuration and symmetrical distribution of the four valencies of tervalent Au and the possible 4-covalency of aurous gold.

The sectional discussions included symposia on the organic chemistry of metals, with emphasis on the noble metals, introduced by Dr. F. G. Mann, on modern methods of chemical analysis, introduced by Dr. J. J. Fox, a discussion on clays, of which the chairman was Professor E. K. Rideal, and one on the repercussions of synthetic organic chemistry upon biology and medicine, introduced by Professor Sir F. Gowland Hopkins. The meetings were punctuated by interesting trips of inspection of the chemistry laboratories, and to the works of the Cambridge Instrument Company in Carlyle Road and by a demonstration of gold films.

The meetings of Section C (Geology) were opened by an address by Professor O. T. Jones on the geology of the Cambridge district. The presidential address was given on Monday, August 22, on "Development and Evolution" by Professor H. H. Swinnerton. Professor Swinnerton considered at length the relative positions of phylogeny and ontogeny in the evolution of organisms, and the similarities and differences between the positions which were first defined by Von Baer and Haeckel on this subject, regarding *juvenile* and *adult* recapitulation. Attention was called to the fact that, on the whole, the more lowly and simple the organism, the more complete will recapitulation be found to be within its race. The phenomenon of localized recapitulation can be found in those organisms which reproduce by budding and a sort of colonial recapitulation in colonial organisms. Recapitulation of adult features occurs most frequently during the neanic period of development, while juvenile recapitulation, while undoubtedly occurring, is harder to elucidate. Coenogenesis (the appearance of new characters at an early stage of development), proterogenesis (the extension of new characters from early to late stages of development) deuterogenesis and tachygenesis (the appearance of new characters at the latest stage of development and their extension to earlier stages) and mutation were discussed and their interrelationships in the formation of the organism described at length. The sectional meetings included a joint discussion with Section K on the post-glacial history of the fenlands, and discussion on the distribution and migration of certain animal groups in the British Lower Paleozoic fauna, on the origin of carbonate rocks associated with alkali-rich intrusions and a series of individual papers. Excursions were included to Barnwell, Cherryhinton and Barrington, Upware and Warboys, Thrapston and Stamford, Breckland, Underwood Hall and Wood Ditton and other points of geological interest.

Section D (Zoology) had as president this year Dr. S. W. Kemp, whose address, entitled "Oceanography and the Fluctuation in the Abundance of Marine Animals," dealt in some detail with the intimate relationship between phosphate content of certain sea waters, especially those of the Channel, and the population of plankton and, ultimately, of fish life in those same areas. Dr. Kemp illustrated his thesis with a rather detailed history of the periodic fluctuations of herring abundance noted in the Channel and other waters over periods of years and the corresponding changes of phosphate content of those same waters. The sectional papers were mostly individual in character, the first several dealing with fish and fisheries, while later ones included discussions of zoological field stations in the United States, the succession of Hemiptera-Homoptera in the afforested areas of Breckland, phases in locusts, diversification of form in medusae and the origin of tetrapods. There was a joint discussion with Section K on the "Mechanism of Evolution," the chairman of which was Professor D. M. S. Watson, and a symposium on sense perception and the evolution of color and pattern introduced by Dr. J. S. Huxley. A semi-popular lecture was given on Monday, August 22, in the Arts Theater by Mr. H. C. Gilson on "Lake Titicaca," followed by biological films. There was a symposium, also, on the role of environment in animal locomotion. There was an excursion to Wicken Fen and Breckland.

The meetings of Section E (Geography) were introduced by the presidential address by Professor Griffith Taylor, on "Correlations and Culture, a Study in Technique." Professor Taylor went at length into the problems of race and language differentiation, pointing out that geography is essentially a liaison science, linking "environmental" with "human" studies. He set forth reasons for feeling that certain peculiarities common to central Asia in ancient times favored the cradling of races of many kinds, and the rapid evolution of new forms from old—notably, perhaps, those of men from pre-men, exactly as we know occurred in the same region for sheep from antelopes. Professor Taylor went on to describe his well-known "zones and strata" theory of cultural evolution, and described the tendency in many different fields, for primitive forms, of culture, race, language or, among animals, species to be pushed to the periphery of a developmental area whose center they originally occupied. Taylor extended the zones and strata concept to many developments to which it ordinarily is not applied, such as the growth of a modern city. The address was concluded with an expression of the futility of such attempted race distinction as has been practiced variously in Continental Europe and by an appeal that the place of classics in a modern education be taken by the social sciences, especially in Australia and Canada. The sectional addresses included a series of papers on the geographical impressions of the Scientific Delegation to India, 1937–38, one on English ports and estuaries in their geographical setting, a discussion on some aspects of the regional concept and individual papers covering such subjects as King George VI Sound in the Antarctic, a description of the Geographical Laboratory, Suffolk agriculture in the Middle Ages, East Anglia and the Civil War, the physiography of Northwest Suffolk, the draining of the Fens, cirque formation in Iceland, the classification of communities by occupation, the Sidmouth coast and the preservation of its scenery, and irrigation in the Canterbury Plains of New Zealand. There were excursions to Hunstanton and to the Fenland, and to the River Great Ouse Catchment Board. The sectional dinner was held on Monday, August 22, and there was a joint tea with Section H at St. Catherine's College on Thursday, August 18.

The president of Section F (Economics) for this year was R. F. Harrod, whose address was entitled "Scope and Method of Economics." Dividing the pure theory of traditional economics into two elements, the first, theory of value and distribution, the second, the statement that productive resources should be so distributed among occupations as to yield an equi-marginal net profit, Harrod discussed economic criteria in general and methods of their examination, including the general static theory of value and distribution, dynamic economics so-called, representing the body of thought relating to the increase or decline of economic magnitudes and empirical economic studies. All three fields, it was pointed out, include powerful tools for the study of economic methods and results, and should be used coordinately. Individual section papers included discussions on the policy of government storage of foodstuffs and raw materials, the present position of sociology, unemployment in relation to the trade cycle, the economic recovery of Germany, public investment and trade cycle policy, professionalism, measurement of the mobility of labor, employment in the United Kingdom since 1929, local diversity of industry and the rate of unemployment, the interpretation and allocation of cost, the business view of the relation between price and cost, overhead costs, international short-term capital movements and the trend of Britain's balance of payments.

Professor R. V. Southwell, as president of Section G (Engineering), gave a penetrating and absorbing address on "The Changing Outlook of Engineering Science." Pointing out the analogy between the modern engineer and the modern medical man, both of whom are charged by society with the obligation to take the new facts discovered by more specialized and more socially remote workers and to apply them practically for the good of humanity, he considered in detail what might in fact be the fate of the relatively generalized engineer in a rapidly specializing world. Will he, in fact, be pushed to the wall by the highly technically trained, but perhaps humanly less competent, industrial physicist and chemist? Will he, within a few years, find that the honorable niche which has so long been reserved for him has, in fact, closed over? Professor Southwell concluded, comfortingly, that this is not true. The job of the engineer differs fundamentally from that of the industrial chemist or physicist in that while the latter will use his training directly in his industrial work, the former is required to learn, not facts, but methods of handling facts and people. Personality is therefore important in the equipment of the engineer, and it is much more important for him to have a broad fundamental grasp of principles than a detailed knowledge of subjects. In the training of the modern engineer, therefore, it is unwise to merely impose "harder papers" in examinations—it is breadth, not detail, of training which is wanted, and sufficient leisure to develop a degree of individual personality. The special outlook of engineers, Southwell felt, will preserve both academic and practical engineering from merging with either chemical or physical research, because of the predominantly applicational aspect of the engineering view-point, as opposed to the more purely detached view-point of scientific research. Southwell strongly urged a closer contact and cooperation between the academic and the industrial engineer—a point strongly stressed by Dr. Fleming in his address to the section last year. In conclusion, Southwell pointed out that the engineer is no more to be held responsible for the awful uses which an unprepared humanity may make of his discoveries and inventions than any other professional worker. In this conclusion, the address strongly reiterated the dicta of Lord Rayleigh in his presidential address. Papers in the section included one on road development, a symposium on vibration, introduced by Professor C. E. Inglis, one on some experience in the use of scale models in general engineering, a joint discussion with Section A on magnetic measurements with special reference to incremental conditions, one on a new torque converter for motor cars, one on engineering instruments and several series of short papers by junior engineers. There were excursions to the works of Messrs. Chivers and Sons, Histon, Messrs. Pye, Ltd., and Messrs. Kryn and Lahey, in Letchworth.

The presidential address of Section H (Anthropology) was given on Monday, August 22, by Dr. V. Gordon Childe, on "The Orient and Europe." Dr. Childe considered at some length the probable extreme antiquity of Oriental culture, and the extent to which it has influenced all the cultural trends of modern Europe. He pointed out how thoroughly the almost purely speculative comment of Montelius in 1899 to the effect that Oriental cultures were already well established and differentiated at a time when the peoples of Europe were essentially without any civilization whatever had been proven by excavated evidence. Excavations have beyond all doubt established the immense antiquity of Oriental cultures, probably reaching back, in the Tel Halaf culture, to 5000 B.C., while work in Anatolia and excavations in Moravia go far toward proving connections between Europe and Asia. The Vardar-Moravia complex establishes at least once a continuity of culture from the Aegean to the Danube basin. On the strict application of Montelius' axiom, the beginnings of the Continental Bronze Age should be nearer 2800 than 1800 B.C. Finally Childe considered the effect that a more contracted chronology might have on Montelius' theory.

The sectional papers showed widely varied interests among the members. They included symposia on Australia and Australian life, introduced by Professor F. Wood-Jones, on the Swanscombe find, on the Middle Paleolithic and on Ritual. The individual papers were extremely numerous and included a very wide range of subjects, representative of which were addresses on the portholed megaliths of the British Isles, the Roman occupation of the Fenland, problems of winter life in Swedish Lapland, Manx house types, some sociological aspects of Cambridge, a new view of Quaternar ave art, the rediscovery of the ancient Orient, prehistoric Anatolia, re-examination of the Piltdown problem, the immense range of natural selection, a religious "racket" in the Gold Coast, the influence of sign language in civilization, calendar customs in the eastern counties, some Welsh light upon the evolution of the chair, survivals in dress and the equipment of the soldier throughout the ages. A sectional reception was held in the Museum of Archeology and Ethnology in Downing Street and at Leckhampton House. There was also an excursion to the Gog Magog Hills on Saturday.

The eye and brain as factors in visual perception, dealing with various aspects of the physiology of vision, formed the subject of the presidential address given before Section J (Psychology) by Dr. R. H. Thouless on Friday. Dr. Thouless discussed the evolution and the limitations of the "Transmission Theory" of vision as understood by Helmholtz, in which all mechanics of the process except those dealing directly with retinal changes were neglected. The transmission theory has been fruitful in the field of sensory physiology, but nearly valueless in the field of perception, because of its neglect of the lack of coordination between images as received and as sensed. Thouless pointed out that there is a discrepancy, very wide among certain individuals, between the image which is received on the retina and that sensed by the brain. Thus the image of a cardboard ellipse falling on the retina will appear to the brain to be circular when in fact it is not so. Similarly, judgments of distance are rarely accurate, being in some individuals too great, in others too small. People having "high phenomenal regression" tend, in general, to judge accurately both of the size and brightness of the objects which they see. Those, on the other hand, whose "phenomenal regression" is low tend to have a wide gap between the images which they see and those which they sense. It seems as if the image as it falls upon the retina acts as a cue or template upon which the mind can build up a picture, but the differences in the composite as against the received picture may be small or relatively great. The tendency to see real characters increases through life. Certain occupational classes seem to select for high or low phenomenal regression: thus artists, as a whole, tend to show a lower, good motorists and taxi drivers a higher, regression in general.

The sectional papers, again, were very numerous and exhibited an extremely wide range of subject and interest. Typical of them were ones dealing with heredity and mental hygiene, the problem of direction of thought, facts and fallacies in the social psychology of early childhood, temperament, social implications of vocational guidance, motor learning and morphology of the responses, recent experiments on birds, acquired color blindness, sensory adaptation in vision and hearing, friendliness and unfriendliness between different social groups, present trends in American psychology, generalized foreign politics, hormic psychology, a joint discussion with Section L on the educational significance of the cinema and wireless, assisting mental hygiene by literature, some verbal problems connected with the definition of personal qualities, examination of behavior in attempting difficult tasks, and some factors affecting the reliability of the interview as a method of obtaining personal information. Excursions were arranged to the Royal Eastern Counties Institution in Colchester and the works of the Cambridge Instrument Company. There was also a demonstration of apparatus and experiments in the Psychological Laboratory.

Section K (Botany) met under the presidency of Professor W. Stiles, the subject of whose address was "The General Physiology of the Plant Cell and its Importance in Pure and Applied Botany." Stiles classified researches upon general cell physiology as belonging in general to four fields: those concerned with the physical and chemical constitution of protoplasm and other cell constituents, with the study of cell enzymes and their action, with problems of cell permeability and with respiration. A considerable discussion of aerobic and anaerobic respiration, with particular emphasis upon the part played by malic acid, was given. The disappearance of malic acid was ascribed to its oxidation to oxalacetic acid, the conversion of this to pyruvic acid and breakdown of the latter on removal of the inhibitor of carboxylase. Further consideration was given of mechanisms of respiration and of the absorption of water by the plant cell and the general phenomena connected with osmosis. The extreme importance of cell physiology in all branches of botany was stressed, and attention was called to its importance in agriculture, through such subjects as nutrition, carbon assimilation, vegetative development, flowering and fruiting. Its importance in food preservation techniques, through studies of rapid freezing and the effect of cold storage upon enzymes, cells and tissues, and in forestry and in the production of such plant products as cotton, linen, jute, rubber, tea, sugar and tobacco was emphasized.

The sectional addresses included symposia on the cultivation of British hardwoods, a joint discussion with Section D on the mechanism of evolution, already mentioned, and discussions on the ecological aspects of afforestation and the present aspects of plant virus research. Individual papers were very numerous. They were represented by reports of researches on the physical nature of the outer surface of the cell walls of the mesophyll of the leaf, the measurement of light in relation to plant growth and distribution, the roles of osmotic and electroosmotic pressures in the regulation of cell turgor, the effects of pressure on the properties of protoplasm, the comparative toxicity of inorganic plant poisons, temperature and the starch/sugar balance in potatoes, the hormone system of the rye grain, the catechol oxidase system, the sexual process in the rust fungi, the vegetation of the Inner Hebrides in the early Tertiary period, the present position of forestry at Cambridge University and a considerable number of ecological, taxonomic and structural papers. There was also a number of excursions, notably to the Roman Road and the Gog Magog Hills, the Cambridge Experimental Area and Conington Hall, to Wicken and to Weasenham Wood. The section dinner took place in the combination room of St. John's College.

The president of Section L (Education) was Mr. John Sargent. His address, "The Function of Administration in Public Education," was delivered on Friday, August 19. It dealt with the character of local administration as it affects school policy, and with suggested changes in it. Sargent pointed out that a vastly increased interest taken by the state in the affairs of the ordinary citizen in recent times has forced home the need for administrative devolution with consequent development of local administrative authority. This raises many problems in relation to the nature of the units themselves. The first is that of size, the present units dating in many cases from Saxon times and being highly non-uniform both in area and in number and character of population. It would be highly desirable to increase the uniformity of the units in these respects. The question of personnel is also a vexing one. The present personnel of educational administrative districts is essentially split into a professional and a non-professional portion, and the latter, again, into persons coopted for their knowledge and interest in education and those chosen by the people not primarily for this quality. The amateur portion of this personnel has deteriorated in recent years, and has come to consist more and more of persons with political aspirations of one sort or another. It was proposed that the educational standard of the personnel be uniformly raised to that of a university training, and suggestions were made as to desirable sizes and numbers of the administrative units.

The sectional papers included a report of the committee on the content of school curricula and discussions on tendencies in the design of schools, on education for a changing society and on the presidential address. An excursion was taken to Bottisham and Linton Village Colleges, and a luncheon was served for the section at Peterhouse at one o'clock on Thursday, August 18.

Section M (Agriculture) met on Friday, August 19, to hear the presidential address, delivered by Professor R. D. Stapledon, on ley-farming and a long-term agricultural policy. The address included a comprehensive summary and analysis of farming methods in Britain, including the arable farm, with crop rotation with or without resort to a one-year ley, the alternate husbandry-ley-farm type, with its arable-grass or grass-arable rotation, the nondescript and the permanent grass farms. Of these, Stapledon believed, the ley type of farm is much superior to any other, and the permanent grass, grazing type, much the worst from the standpoint of efficiency, cleanliness and soil fertility. An extensive discussion was given of the ley, arable-grass type of farm, on which the speaker is an eminent authority. The address was closed with a discussion of plans for governmental loans to farmers, the "loans with advice" scheme, practiced in America, being most advocated. Rehabilitation loans to specially suitable areas were also recommended.

The section papers included comprehensive discussions on agriculture in relation to national employment, the practical problems of crop production and the practical problems of animal production. Visits were undertaken by the section to the University Farm Plant Breeding Institute, to Cressing Temple, Braintree, Lord Rayleigh's Farms, Hatfield Peverel, the Henry Ford Institute of Agricultural Engineering at Chelmsford, Little Hallingbury Park, at Bishop's Stortford and the farms of Messrs. Chivers and Sons, Ltd., at Histon.

Two evening discourses were delivered to members of all sections. The first, by Dr. H. Godwin on "The History of the Fens," was given in the Arts Theater on the evening of Friday, August 19, and the second, delivered in the theater on the following Monday, dealt with "The Contribution of the Electrical Engineer to Modern Physics," by M. L. Oliphant. Meetings of the Delegates of Corresponding Societies for the Association met on Friday, August 19, and on the following Monday to discuss matters of common interest to the societies and the association. The presidential address, entitled "The Importance of National Parks in the Preservation of the Flora and Fauna of Great Britain" was delivered by Rt. Hon. the Earl of Onslow. The delegates had dinner at the Dorothy Restaurant on Friday, and a visit was organized to the University Botanic Gardens on Monday.

A university reception for members of the association was held in the Senate House and Old Schools by the vice chancellor on Thursday evening, August 18, and on the evening of August 23 the Mayor and Mayoress of Cambridge invited members of the association to a sherry party in Emmanuel College. The masters and fellows of Downing College invited five hundred members of the association to a garden party in the grounds of the college on Friday afternoon. Similar invitations, to varying numbers of members, were issued by the masters and fellows of Sidney Sussex, Christ's and Queen's Colleges.

The masters and fellows of Trinity and St. John's Colleges invited a limited number of members of the association to informal conversaziones on Friday and Monday evenings, respectively. A dance was held in the ballroom of the Dorothy Café on Saturday evening, while the Cambridgeshire Branch of the English Folk Dance and Song Society invited members of the association to a party held in King's College Fellows' Garden, on the afternoon of Thursday, August 18.

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SPECIAL ARTICLES

EQUINE ENCEPHALOMYELITIS PRODUCED BY INOCULATION OF HUMAN ENCEPHALITIS VIRUS

Fothergill *et al.*[1] and Webster and Wright[2] have reported the recovery of a filterable virus from the brains of children, of a nature very similar to equine encephalomyelitis virus (Meyer). A sample of one strain of the virus was submitted by Dr. Fothergill to the Pathological Division of the Bureau of Animal Industry through Colonel R. A. Kelser, U. S. Army Veterinary Corps, on September 24, 1938.

The virus, represented by portions of mouse brain in glycerine solution, was triturated on the day of receipt in a Ten Broeck tissue grinder, and an approximate 1.5 per cent. suspension in physiological salt solution was prepared. The suspension was cultured on serum agar slants and in beef infusion broth, which subsequently remained free of bacterial growth. Following culture and during the procedures of inoculating the trial horses, the brain suspension was kept in a container of iced water.

Three horses, one normal, an eastern-type[3, 4, 5, 6] immune and a western-type immune were injected intracerebrally under local novocain anesthesia with 1 cc of the prepared suspension on September 24. Immediately following, on the same day, six guinea pigs were injected intracerebrally with 0.1 cc of the same suspension. All inoculations were completed by 1 P.M. On September 25 in the late afternoon the control horse had a temperature of 104.2° F. and the western immune a temperature of 101.8° F. On the days following, typical, progressive symptoms of encephalomyelitis (congested, "muddy" and icteric mucosae; maximum temperatures of 105.4°F. and 104.0° F., depression, stupor, anorexia, myopalmus, dehydration with rapid loss of flesh, splanchnic ridge, progressive weakness, paralysis and final collapse in recumbency) developed in both these animals. The normal animal (No. 1100) was sacrificed when completely prostrate on the third day after inoculation, September 27. The western-immune (No. 1011—vaccinated 5/12 and 5/19/38 with formolized western type encephalomyelitis chick embryo tissue vaccine and exposed intracerebrally to western [Iowa-1937-1] virus 8/25/38—survived, after showing only a slight, transitory, febrile reaction and mild indisposition) was dead on the morning of the fourth day after inoculation, September 28. The eastern-immune (No. 1042—exposed intralingually 6/28/38 to eastern virus [South Carolina-1937-1]—developed typical, severe encephalomyelitis, recovering without treatment) remained normal and continues to be so at this writing.

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[1] Leroy D. Fothergill, John H. Dingle, Sidney Farber and M. L. Connerley, *New England Jour. Med.*, 219: 12, 411, 1938.

[2] Leslie T. Webster and F. Howell Wright, Science, 88: 2283, 305–306, 1938.

[3] L. T. Giltner and M. S. Shahan, *North American Veterinarian*, 14: 11, 25–27, 1933.

[4] M. S. Shahan and L. T. Giltner, *Jour. Am. Vet. Med. Asn.*, 86: n.s. 39, 6, 764–772, 1935.

[5] Carl Ten Broeck and Malcolm H. Merrill, *Proc. Soc. Exp. Biol. and Med.*, 31: 217–220, 1933.

[6] B. F. Howitt, *Proc. Soc. Exp. Biol. and Med.*, 35: 4, 526–528, 1937.

All the guinea pigs injected with the suspension of mouse brain likewise developed symptoms of typical encephalomyelitis (eastern type virus infection) and died, or were destroyed for harvesting of virus when prostrate, on the third to fourth days following injection. A subsequent, bacteriologically sterile passage of the virus from two representative guinea pigs in the group was effected. Suspensions of brain tissue from the two horses (1100 and 1011) also produced typical, bacteriologically sterile encephalomyelitis in guinea pigs when inoculated intracerebrally.

The symptoms in the inoculated animals, the comparatively brief incubation period, the acute course of the disease, the immunity against the injected virus in the eastern-type-encephalomyelitis-immune horse and the equal susceptibility of the normal and the western-type-encephalomyelitis-immune horses add conclusive evidence that the virus recovered by Dr. Fothergill from a human case is indistinguishable from eastern-type equine-encephalomyelitis virus. It may be further noted now that all five of the strains of equine-encephalomyelitis virus which have been recovered by the Bureau from Massachusetts horses during the August–September, 1938, epizootic have been definitely determined to be of eastern type through exposure of guinea pigs immunized against eastern and others immunized against western type equine vira.[7]

The addition of man to the list of species susceptible to equine-encephalomyelitis virus again brings to the fore the problems of epizootiology in connection with the equine disease and justifies further consideration and investigation of the role which the many other known susceptible species[8, 9] might have in the spread of the disease amongst horses, as well as to or from the human family.

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THE BEHAVIOR OF THE VIRUS OF YELLOW FEVER IN THE MOSQUITO, AËDES TRISERIATUS[1]

THE extrinsic incubation period of yellow fever was described by Corré, and the time limits of this period were determined with a very considerable degree of accuracy by Carter[2] in 1898 before this disease was known to be transmitted by the mosquito, *Aëdes aegypti*. The conclusions of Carter were based on data obtained from his observations of epidemics of yellow fever under natural circumstances. Within the past decade methods have been developed for the study of yellow fever under experimental conditions, more particularly by the infection of monkeys and mice.

In 1904, Dr. Smith,[3] of New Jersey, raised the question whether the mosquito *Aëdes triseriatus* (Say, 1823) prevalent in that state might conceivably serve as a vector of yellow fever. This mosquito is neoarctic in its distribution, and it has been described as occurring from Maine as far southward as Florida and westward to Montana, an area which lies outside the endemic zone of yellow fever. Our experiments were conducted with mosquitoes (*A. triseriatus*) from the region of Ithaca, N. Y. One of us (Baker) succeeded in establishing a colony of this species in a greenhouse insectary at Cornell University. The first experiment in transmission was conducted at the Harvard Medical School in the autumn of 1935, using the technique which we have ordinarily employed with *A. aegypti*.[4] About 35 mosquitoes (*A. triseriatus*) were given an infective feeding on a monkey (*Macacus rhesus*) dying of yellow fever. After an incubation period of 17 days, at about 28° C., 7 of these mosquitoes were living and 6 fed on a monkey. Six days later there was an indefinite febrile reaction (104.1° F.) on one day only, and the monkey remained in excellent condition. One month after the mosquitoes had fed arrangements were being made to inject yellow fever virus for an immunity test. Fortunately a delay of a few days occurred and no injection was made; this monkey died of yellow fever 36 days after being bitten by mosquitoes. In the meantime, the colony of mosquitoes at Cornell had been discontinued.

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[7] Unpublished work.

[8] L. T. Giltner and M. S. Shahan, SCIENCE, 78: 2012, 63–64, 1933.

[9] L. T. Giltner and M. S. Shahan, *Jour. Am. Vet. Med. Asn.*, 88: n.s. 41, 3, 363–374, 1936.

[1] From the Department of Tropical Medicine, Harvard Medical School, Boston, Mass., and the Department of Entomology, Cornell University, Ithaca, N. Y.

[2] H. R. Carter, *New Orleans Med. and Surg. Jour.*, 52: 617–636, 1900.

[3] J. B. Smith, "Report of the New Jersey State Agricultural Experiment Station, Trenton, New Jersey." MacCrellish and Dingley, State Printers: Trenton, N. J., 1904.

[4] A. W. Sellards, *Am. Jour. Trop. Med.*, 12: 79–92, 1932.

It was not feasible to resume this work until the present year. In March, larvae (*A. triseriatus*) were collected from tree-holes at Ithaca and reared in the laboratory of the Department of Entomology at Cornell University. Mosquitoes which had previously taken an infective blood meal were allowed to feed on four monkeys. These animals showed no febrile reaction, but two of them died of yellow fever after intervals of 10 and 13 days. Blood taken from the two surviving monkeys failed to protect mice against yellow fever. The two monkeys which survived were bitten by mosquitoes which were kept for 14 to 15 days at about 28° C., whereas the two monkeys which died were infected by mosquitoes which were incubated at 37° C.

Ten mosquitoes which had ingested infective blood of dying monkeys were tested for virus after incubation periods of 13 to 16 days. Each mosquito was ground in a mortar with a little serum-saline, and injections were made intracerebrally in white mice. The virus was recovered from 6 of these 10 mosquitoes.

Briefly, the virus of yellow fever in its ordinary form was transmitted to monkeys (*Macacus rhesus*) by *Aëdes triseriatus*, and there was some evidence of attenuation of the virus in this mosquito.

Byron L. Bennett
Fred C. Baker
Andrew Watson Sellards

CORRELATION BETWEEN SELF-BREAKING AND BLUE NUCLEI AMONG CERTAIN COMMERCIAL TULIP VARIETIES[1]

It has been pointed out in "The Antithetic Virus Theory of Tulip Breaking"[2] that while the virus content of the plant determines the type of breaking in all pink and nearly all red tulips some dark red varieties always self, regardless of their virus content. In such tulips the dark red anthocyanin of the flower epidermis is darkened in certain areas and left unchanged in others; the ground color is not exposed. Likewise the black tulip, La Tulipe Noire, when infected with a virus, merely darkens. Several years ago the writer made the unpublished and then unrelated observation that nuclei apparent in mounts of the flower epidermis of La Tulipe Noire are sometimes blue. A study of virus effects on the new race of tulips known as Mendel tulips has shown that without exception every red Mendel variety bearing flowers with a white ground and blue base, selfs or darkens when inoculated with inoculum containing tulip virus I, the color-removing virus. Of the 49 red varieties studied, 21 evidence a blue pigment in the epidermis of the basal portion, which occurs (1) free in the cytolymph of epidermal cells, (2) as prismatic crystalline masses, (3) *within the nuclei of the cells* or (4) in combinations of these three conditions. Frequently, the nuclei are so blue that no structure can be seen within them. The pigmentation of the nuclei is greatest in cells that are beginning to degenerate but is also evident in cells that are apparently healthy. There is no correlation whatever between the presence of a virus and the occurrence of these blue nuclei. The pigment is present in both healthy and diseased individuals, and blue nuclei are evidenced wherever it is abundant. A further study of La Tulipe Noire shows that its approach to blackness is due to the presence of intensely blue cells scattered among the dark red cells of the flower—the nucleus-staining pigment is not confined to the base of the flower. The blue pigment reacts positively to the qualitative reactions for an anthocyanin, changes to a rose color at pH 4.5 and to a yellow-green between pH 7 and 8. Solubility tests tend to differentiate it from the conspicuous red anthocyanin of the tulip flower. Blue nuclei are found in the bases of red Darwin tulips that likewise self in the presence of the color-removing virus. It is not claimed that all red tulips having this pigment will always self, but no exception has been found for dark red Mendels.

Freshly made mounts of tulip flower epidermis are beautiful microscopical objects. The clarity of the self-staining of the pigmented nuclei offers an exceptional opportunity for nuclear study, especially since the pigment seems confined to the karyolymph. Moreover, the blue pigment acts as a selective intravital stain and exhibits vacuolation phenomena with astounding clearness.

Frank P. McWhorter

Oregon Agricultural Experiment Station,
Corvallis

SCIENTIFIC APPARATUS AND LABORATORY METHODS

A SIMPLE COMBUSTION TYPE OF CARBON MONOXIDE ESTIMATOR

This method depends upon the conversion of carbon monoxide into carbon dioxide by combustion and the reaction of this carbon dioxide with strontium hydroxide (or other alkali-earth hydroxide), using phenolphthalein as an indicator. Obviously any carbon dioxide or hydrocarbon vapor which may be present in the air must be removed or high results will be obtained. A simple and inexpensive apparatus using this principle and sufficiently accurate for industrial health purposes is shown in Fig. 1.

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[1] Published as Technical Paper No. 289 with the approval of the director of the Oregon Experiment Station. Contribution of the Department of Botany, Oregon Experiment Station, in cooperation with the Bureau of Plant Industry, U. S. D. A.

[2] *Annals of Appl. Biology*, 25: 254–270, 1938.

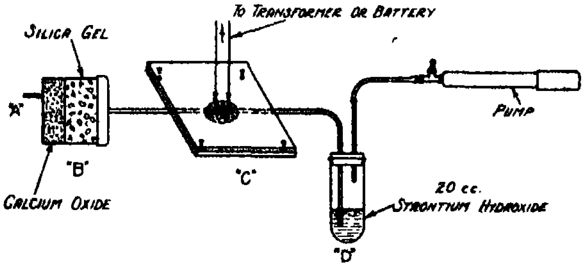

Fig. 1

The letter "A" designates the inlet to the apparatus. 3/16 inch copper tubing with brass fittings similar to those on automobile gasoline lines are used. The canister "B" is of tin and should have a capacity of at least four cubic inches. This canister is two thirds filled with silica gel and one third with calcium oxide for removal of hydrocarbon vapors and carbon dioxide, respectively. The copper outlet tube from canister leads to the combustion unit "C." This unit consists of two 3 inches × 3 inches × ¼ inch pieces of transite (Johns-Mansville) board bolted together with 4-⅛ inch brass bolts. A suitable central recess is made in one board as shown to carry the heating element of a *nineteen cent automobile cigar* lighter unit. These units are obtainable with one bolt terminal, and the other terminal may be made by notching out the head of a small cylindrical headed bolt and swedging the other end of the element in this notch. The edges of the transite board are made air-tight by the application of a small amount of furnace cement. The exit tube of the combustion unit is connected to a small bubbler "D," as shown. A suction pump of 55–60 cc capacity per stroke can be conveniently made from a 10 inch bicycle pump. A 3/16 inch tee is sweated to the bottom of the pump and then two ball check valves to the tee as shown. The current for the combustion unit may be furnished by a toy transformer supplying nine volts or from a six-volt storage battery.

The solution used in the bubbler is 1/2,500 normal solution of strontium hydroxide. This solution is conveniently standardized against 1/50 normal sulfuric acid (0.55 cc of conc. sulfuric acid (sp. gr. 1.84) in one liter of solution). 100 cc of strontium hydroxide solution is equivalent to 2 cc of N/50 sulfuric acid. Each liter of the strontium hydroxide solution should contain 15 cc of 0.1 per cent. phenolphthalein in 85 per cent. alcohol. The solution is stable if kept away from air containing carbon dioxide. If 20 cc of this solution is placed in bubbler and air pulled through at a rate of 100 cc per minute, then Table I will apply.

TABLE I

If red color (phenolphthalein) disappears after:	
Number of pump strokes	Parts per million of carbon monoxide present
1	2,000
2	1,000
4	500
8	250
16	125

J. B. Ficklen

Travelers Insurance Company,
Hartford, Conn.

GROWING FUNGI ON CELLOPHANE

Various saprophytic fungi (Aspergillus, Fusarium and Verticillium) isolated from dead leaves were grown successfully on rolls of filter paper and of Cellophane in test-tubes. Each tube contained a few cc of Knop's solution with which the rolled sheets were in contact and by which they were continually moistened. Growth was equally good on both media. The transparency of the Cellophane permitted one to observe the growth of the organism directly, even with considerable magnification. The cellulose acetate appears to be partially hydrolyzed during sterilization and to improve the Knop solution as a nutrient for the fungi.

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CLINICAL INVESTIGATION[1]

By Dr. GEORGE R. MINOT

PROFESSOR OF MEDICINE, HARVARD UNIVERSITY, DIRECTOR, THORNDIKE MEMORIAL LABORATORY, AND VISITING PHYSICIAN, BOSTON CITY HOSPITAL

WE are here to-day to celebrate the opening of the Squibb Institute for Medical Research, which stands as a fitting tribute to Edward Robinson Squibb, the founder of this distinguished pharmaceutical organization. Dr. Squibb was an eminent physician and chemist and his name has become synonymous with certain ideals in medicine and pharmacy. The scientist's love for truth, so marked in him, and the painstaking and conscientious care of every detail of his activities led him to never neglect research and general scientific work, which he recognized as essential. Dr. Squibb's services to the army and navy, especially during the Civil War, were most significant, for he supplied them with highly dependable medical supplies and particularly anesthetics. His master formula was honor, integrity and trustworthiness. His work was such that no contemporary had to consider writing such a book as Christopher Merrett wrote in 1669 with the title, "A Short View of the Frauds and Abuses committed by Apothecaries; as well in Relation to Patients, as Physicians: and the only Remedy thereof by Physicians making their own Medicines." Dr. Squibb's published investigative studies extended from 1855 to 1900, in which year he died at the age of eighty-one. The studies concern especially the production and preparation of therapeutic substances which the physician prescribes and which must in final analysis be tested on human beings for their exact action and value—a form of clinical investigation.

It is a physician who undertakes clinical investigation, and I plan to consider a few general aspects concerning this subject especially as referable to the physician and patient.

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[1] Presented at the dedication exercises of the Squibb Institute for Medical Research, New Brunswick, N. J., on October 11, 1938.

Doctors deal with human problems, and to solve them an active creative imagination and scientific curiosity are necessary tools. Every patient who consults a doctor presents a problem for investigation before the best advice can be offered. There is nowhere that a patient stands so good a chance of being benefited as in a clinic where his disease is arousing scientific curiosity. A studious inquiry of sick people is what every good practitioner makes daily. At the bedside he must constantly sharpen his powers of observation and judgment and recognize that his education is never ended but must be continued by his own strenuous mental effort. Any doctor should appreciate the spirit and understand the principles of research and develop an investigative habit of mind. His curiosity to learn must never wane, for if it does he soon will become inefficient. Since medicine deals so essentially with human problems the physician must constantly strive to broaden his outlook on life. This may be done by cultivating interests that often would be considered far removed from the practice of medicine, such as some aspects of natural history or art. These various attributes of a physician must be applied at the bedside in the elucidation of the phenomena of disease. There is no sharp line of demarcation between the practicing physician and the physician who makes it one of his duties to conduct clinical investigation. Indeed the best sort of properly trained clinical investigator must be an able clinician, one who understands human beings and can act wisely for all aspects of a given individual. His training in investigative principles must be sound, and he should have an ardent desire to seek for knowledge by scientific methods. In other words, he must wish to carry the torch forward so that the oncoming generation of physicians will find it nearer the ultimate goal.

Clinical investigation may be pursued in institutions designed only for that purpose or in any hospital. It may also be undertaken wherever the physician has his headquarters if he trains himself to keep in mind the study of problems. The establishment of appropriate space and opportunities for clinical investigation in large hospitals where the study of patients under controlled conditions can be undertaken seems especially wise. This permits investigators to be surrounded with a wealth of clinical material for study from which ideas can originate and allows the hospital to be a progressive modern institution and the patients to receive the very best treatment. It is of great advantage if the clinical investigator is in close contact with men working in a wide variety of scientific fields and especially in those disciplines closely related to clinical medicine, such as pharmacology, bacteriology, chemistry and biology, as you have here in this institute. Mingling of such men offers opportunity for the free exchange of thought which can lead to beneficial results. Indeed this arrangement allows the ideas originating from the needs of the patient to be readily carried for elucidation to some laboratory of fundamental science, and knowledge obtained there to be applied in the clinic. For the cure and prevention of disease and the relief of pain the final test is on man himself, so that a clinical investigative unit need be a part of, or associated with, an institute for medical research. The director of this institute, Dr. Harrop, certainly appreciates this, if for no other reason than because of his well-recognized accomplishments in the fields of experimental medicine and clinical investigation, which make advances hand in hand. I am delighted to learn that clinical facilities with a small ward for the observation of patients in connection with various problems being studied by the research staff are being planned.

Clinical investigation does not necessarily require great laboratory set-ups. The sick individual is the center of the picture, so that wards with patients are the salient feature of the clinical investigative unit. Clinical investigations frequently are suggested from individual patients' problems, and these may concern matters removed some distance from the patient himself. Indeed, clinical investigation may necessitate pursuit at a distance from the investigator's headquarters or institute because the solution of problems may be found, for example, in the physical, biological or social aspects of a patient's community or home. The technical apparatus required for intelligent observations and for the proper care of the patient is but a means to an end and is a relatively insignificant, though often to the casual observer the most impressive, feature of a clinical investigative unit. The most important and significant possession, besides the sick people, is the recorded data collected with a view to obtaining a definite pattern and often ascertained by simple procedures, frequently entirely by the use of the intellect. It is from the trustworthy records of natural phenomena and of the actions of organisms under controlled experimental conditions that concepts concerning disease are formulated leading to the alleviation of man's ailments and to knowledge of intrinsic scientific interest. The plodding worker often obtains a long record and masses of data which are sometimes thought to be an indication of good work. That is often far from the case, because the data recorded may have been obtained without critical understanding. Quantity does not supplant quality. The individual with an aggressive inquiring mind can often by skilfully planned questions and observations in relatively small quantity elicit more significant information than is found in some voluminous records. Thus the foundation of research work lies in the quality of the minds of the investigators and the freedom and tranquility permitted for the use of their abilities. Free choice of problems and free choice to follow leads disclosed must be the privilege of the experienced investigator.

Although any physician may conduct clinical investigation and share his knowledge with his colleagues, the term clinical investigator is usually applied to a man who devotes a considerable amount of time to the study of clinical problems in organized clinical laboratories. Many men who essentially never observe a patient work in numerous fields of science studying problems pertaining to the clinic, but such individuals are not clinical investigators.

A trained clinical investigator may approach problems, broadly speaking, in two different ways. In the first instance an experienced clinician seeks tools through which to solve problems that originate in his mind at the bedside; for example, the man who appreciates that to supply the deficiency of the blood-clotting mechanism in hemophilia chemical procedures should be utilized in an effort to discover something that might permanently alleviate the patient if given by injection each day. The second method of approach is also for a man with clinical training, but one who has acquired the use of tools, to take them to the bedside to apply them to problems suggested by the tools; for example, a man trained in chemistry and especially in the chemicophysical aspects of the clotting of blood, who seeks a patient to elucidate the mechanism of blood coagulation. The former is more truly the clinical investigator, and it is by the intellectual rather than by the technical method that he approaches problems, concerning sick individuals. This does not imply that it is unwise for investigations of fundamental importance to proceed from purely morphological, chemical or physiological motivations without reference to the immediate needs of the clinic, for it is by the study of fundamental problems that most significant advances are made. Both types of clinical investigators have their place in the development of useful knowledge, but if aggregations of individuals, chosen only because they are acquainted with special techniques, form the personnel of a clinical investigative unit the practical needs of clinical medicine are apt to be forgotten.

It is certainly an incorrect conception of research that it makes a man heartless, unsympathetic or indifferent to human suffering. Indeed, many able clinicians who have spent much time in investigation are unusually keen in their ability to appreciate and to treat wisely the anxieties and emotional disturbances of patients. In reality the clinical investigator is apt to be successful somewhat in proportion to his appreciation of the sick man as an individual. He is usually one who has some inborn quality which fits him for an earnest search for knowledge and who by proper training in a suitable environment develops his inquiring abilities. He must have the power to see straight, which is a rare gift. To see no more and no less than is actually before one, to see with one's reason as well as with one's perceptions—that is to be an observer and to read the book of nature aright. To note the resemblances of things one to another may be an essential point in acquiring information. Factors often need study one at a time, yet it must not be forgotten that synthesis is essential in the formulation of final knowledge. The investigator must ponder on topics where emotions blend with cold reason and where the answer is dictated by the emotions, though it is largely formed by reason. Emotion is the driving force that arouses inquisitiveness, sustains interest and keeps the investigator at work through drudgery. Reason is the critical control that guides and checks progress. It is developed by long training in the scientific method. Emotion and reason are always mixed; one can only do one's best to use each for its serviceable purpose and avoid the usual mistake of allowing emotions to dominate one's judgment.

The problem of whether a man is to undertake clinical investigative work does not depend on his precise occupation but lies in the man himself. He who undertakes clinical investigation, however, must learn to recognize clinical facts, realize that intuition often guides and that the patient's health must never be jeopardized. He must establish a detailed diagnosis without pothering over unessential details and proceed to action for every aspect of the patient and his case. Anything studied faithfully develops the mind. Thus, besides what is gained by investigative work itself, this type of work has great educational value. Every physician must be trained to look at problems from more than one angle and be unwilling to confine himself to standardized procedures. Throughout life the physician must keep abreast of the times and, by making frequent contacts with those especially studying medical problems, he will constantly imbibe knowledge. An understanding of the principles of scientific investigation aids him to judge critically, to appreciate the nature and significance of proper controls, and to evaluate the significance of the many communications published on medical topics.

Before a problem is intensively studied it is essential to become acquainted with previously acquired knowledge on the subject. Although subservience to the past makes stagnation, development of it is true progress. Science may render that which went before obsolete, but it builds upon the past, constantly advancing new knowledge from the standpoint of the already known. Thus the investigator must consult authorities in large part by going to the library. Consulting colleagues is extremely helpful but does not alone take the place of reading what has been written on a subject. Conversation alone as the only basis for obtaining information can lead to confusion between "authority and the oracle," which is perilous to scientific work. A library is not merely a hall of books but a hall of records of human experience and thought, where one may learn the path along which man has toiled and may discover guiding and liberating influences for the future.

Clinical investigation takes a variety of forms. The aim should be to undertake fundamental problems and to appreciate that progress in the clinic often owes its origin to the fields of pure science. The studies are often of a collective nature, as in the evaluation of clinical data, the evaluation of new procedures or in the correlations of chemical and pathologic information. Proper statistical methods must be employed and standard deviations and probable errors calculated. The descriptive discipline of nosography—the painting of accurate pictures of disease—is a useful guide to keep experimental procedures from going astray. This type of work may depend on the good fortune of observing several cases and not on planned investigation. There is need for more accurate work of this sort especially concerning initial symptoms and the natural history of long-lasting chronic conditions. Controlled observations of human pathologic physiology is the nature of many of the studies of the clinical investigator. The question of the origin or cause of disease is of unusual importance to study. Therapeutics, which is linked with pharmacology, is essentially an experimental science and will always have experimentation on man for its chief basis. The action of drugs always needs evaluation. The object, however, is to study the human body and not drugs *per se,* and one method of doing so systematically is by means of its reaction to chemical and physical agents.

The control of experimental conditions in human beings is crude as compared to the utmost rigidity in the control of the worker in pure science, so that data of observations may be only qualitative or but crudely quantitative. One of the many variable factors is dependent on the fact that the human being has a soul and highly organized nervous system. His emotional reactions, worries, jealousies and the like and his reactions to one or more persons can not only lead to illness but affect the functions of organs. The medical-social, psychological, economic and allied aspects of individuals can be investigated with profit. The field is a difficult one for reliable scientific study, because it involves all the complexities of human life. Even so, a considerable fraction of the successful care and treatment of patients and the prevention of much illness is to be identified with the proper consideration of their medical-social problems. A list of the studies a clinician may pursue is of little value. It is more significant to realize that a prepared mind, well-planned scientific observations and the taking of infinite pains will lead to success, and that important original contributions often are made which require only simple technique and clinical wisdom.

The clinical investigator in his search for truth is not to be thought of as a lone worker or as a man sharply separated from other types of doctors. A close relationship with practitioners, specialists, pure laboratory investigators of many types is mutually beneficial. The men in this institute, like investigators elsewhere, naturally realize that assistance may be obtained from a wide variety of divergent sources and that science is not bounded by the walls of any one institution. There are no sharp lines of demarcation between one medical interest and another or between medicine and a variety of disciplines. Cross-fertilization at the border lines of knowledge can serve to develop new information. The advancement of learning can not be made in water-tight compartments. Modern developments have permitted team work in scientific fields to be much more general and prolific where before isolated efforts were the rule. Cooperative investigations between physicians, scientists and all types of scholars trained in different ways as well as between men in different institutions can enhance knowledge concerning the treatment and prevention of disease and the happiness and progress of a people. Such cooperation when spontaneous is fruitful, but when compelled it may be sterile.

More fundamental than the actual discoveries being made to-day is the preservation of the right to engage in research. If all governments, races and individuals would hold the same high ethical view-point of life that Dr. Squibb did, there would be no murmurings of intolerance to intellectual freedom. Security and happiness have profound beneficial effects on the character of intellectual work. As time passes by we must always be alert to adapt ourselves to changes and realize that to understand the present we must look both towards the past and towards the future.

BIOLOGY AND INDUSTRY IN COOPERATION[1]

By Professor AUGUST KROGH

HEAD OF THE DEPARTMENT OF ANIMAL PHYSIOLOGY IN THE UNIVERSITY OF COPENHAGEN

IT is a great pleasure as well as a great honor to assist at the inauguration of these laboratories, which represent a very important step forward in the ever closer cooperation between biological science and biotechnical industry.

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[1] Presented at the dedication exercises of the Squibb Institute for Medical Research, New Brunswick, N. J., on October 11, 1938.

That industrial development is deeply influenced by scientific discoveries has long been recognized in the case of physics and chemistry, and I need only mention such names as Faraday, Oersted and Hertz and the electrical industry to make it clear to you how enormous the influence has been.

The influence of biological sciences on what I would call biotechnical industries is a later development, but not less profound, and the relations between industry and biological science is, as all good and durable relations should be, by no means one-sided, but mutual, science deriving extremely valuable help and stimuli from the industries. I propose to discuss briefly such mutual relationships as illustrated by conditions in Europe and I shall go a little more into the relationships in Denmark to which I can claim some first-hand knowledge.

The preparation of biological products for human use and consumption is as old as civilization itself. The fermentation of sugars was utilized before the dawn of history, products of the silk industry in China reached the western world by trade centuries before any European had ever visited the Far East. It is a cause for wonder how many potent drugs were discovered by a process of practically unconscious trial and error through many generations in remote antiquity.

Until about a century ago the preparation of biological products, including drugs, took place largely as home industries and on a small scale, while the manufacturing processes were the results of tradition created by practical experience. Mishaps were very common, but their effects local and as a rule not very serious. There were as a matter of course large variations in the fermentations underlying the productions of wine and beer. Bacteria would occasionally make their appearance and spoil the products completely, and diseases would attack the plants which supplied the raw materials. Large variations occurred in the potency of drugs, but were rarely discovered because of the lack of precision with which their effects could be determined.

The difficulties became apparent and their seriousness appreciated when attempts were made to work on a large scale, and science was called in to help solve these difficulties. The work of Louis Pasteur furnishes one of the oldest and certainly the most brilliant example of what science could do to help biotechnical industries like the production of wine, beer and vinegar and, the most spectacular of all, his saving of the French silk industry in the years 1865–71. In Denmark the scientific work in the interest of agriculture dates back to about the same time and has been vigorously prosecuted ever since.

Assistance rendered by science to industry was necessarily the first step to make industry interested in the development of science and the mutual help has naturally taken many different forms.

A close and fruitful cooperation between science and pharmaceutical industry is illustrated in the history of the firm of Merck at Darmstadt. The apothecary Heinrich Emanuel Merck started a production of purified drugs, especially alkaloids, on a comparatively large scale in 1827. He was the owner of the Angel Pharmacy, which had at that time been in the possession of the family during five generations and for over 150 years. He was a very good chemist, a close friend of Liebig, and had himself worked out methods for the isolation and purification of several alkaloids. It is a very remarkable fact, speaking highly for his scientific spirit, that he did not keep his methods secret, but published his results in sufficient detail to allow others to benefit by them.

The firm was carried on as a family undertaking. At the present time it has, under the direction of the great-grandsons of Heinrich Emanuel, grown into a huge concern and is doing a large amount of scientific work in the interest of the firm. They have very large laboratories for the synthesis of substances. They have pharmacological, chemotherapeutic and bacteriological departments for the exhaustive study of the action of their preparations on the animal and human body, for the control of sterility, and so on. An important new branch is concerned with the application of micro-organisms for the production of new substances by their controlled activity.

H. E. Merck a hundred years ago kept up a considerable correspondence with scientists in Germany and elsewhere, both giving and receiving suggestions and advice, and out of this has grown the "scientific department" of the present firm, whose chief business it is to keep in touch with practice and with independent science. They receive and examine all kinds of hints and suggestions with regard to the activity of the firm, trying to meet the wishes of individual workers, and they also take care of all inquiries, general or special, and supply information not only from knowledge directly available in the minds and memories of scientists in the employ of the firm, but in many cases they also undertake a search of the literature and even go to the length of actual experimentation to satisfy inquirers. The value to independent workers of thus having at their disposal the accumulated experience and knowledge of experts can scarcely be overestimated.

I would like to emphasize the services rendered to science by the firms supplying pure chemicals and pure drugs. It does not seriously detract from these services and it shows the difficulty of the task that in spite of all care the purity obtained is not always sufficient. There is a recent example studied by Güntelberg in Denmark, where it was found that a content of 0.05 per cent. bromine present in analytic chloride preparations from a number of firms had disastrous results in electrometric pH measurements, and a few years ago the presence of minute traces of silver in sodium chloride made Ringer solutions definitely poisonous for fish hearts.

The firms are, as a rule, ready to render assistance when new substances are desired for experimental purposes, and I would like to mention a point where demands are being made which, if they can be fulfilled, will prove of very great value to experimental biochemistry. I refer to the production of organic substances like amino acids and lipoids containing deuterium instead of hydrogen in certain selected positions in the molecule. If such substances, which are, as we call it, "labeled" by the content of deuterium, but chemically identical with those containing ordinary hydrogen, can be made available they will be extremely useful in the study of intermediate metabolism.

It is of course impossible to mention here all the firms which by the work in their own laboratories have rendered services of great value to biological science, and I am fully aware that my selection is largely arbitrary and determined by my personal interests. I can not refrain, however, from referring to the brilliant work by Stoll, Rothlin and their collaborators in the firm of Sandoz. Unlike most other firms, they have cultivated a restricted field and made fundamental contributions to the chemistry and pharmacology of the alkaloids from Secale and the glycosides from Digitalis, Scilla and Strophanthus.

I would also mention the work done in the laboratories of Hoffman la Roche on the synthesis of vitamins and the work done in the laboratories of the firms Ciba, Organon and especially Schering, on the isolation, determination and synthetic preparation of sexual hormones as well as their contributions towards the clearing up of the terribly complicated problems relating to the pituitary hormones. To the work on sex hormones also the laboratories of Danish firms (Leo) have made notable contributions, and I want to emphasize the point that in the academic study both of vitamins and of hormones the laboratories of commercial firms have played a very conspicuous part and greatly accelerated progress.

So far as I have been able to ascertain the laboratories mentioned are all rather intimately connected with the firms supporting them, and each works ultimately in the interests of the firm. Certain leaders of industry, however, have been broad-minded and deep-sighted enough to create and support laboratories for fundamental research having for their avowed object the progress of science and the furtherance of industry generally without regard to the interests of their own firm. The example best known to me is the Carlsberg Laboratory, founded by the proprietor of the Carlsberg breweries, J. C. Jacobsen, in Copenhagen and almost at once handed over, together with the necessary capital, to an independent trust, the "Carlsberg Foundation," the members of which were selected by and among the Danish Royal Society of Science and Letters.

The Carlsberg Laboratory began work as early as 1876. The main object was stated in the words, "To provide a scientific basis, as complete as possible for the operations of malting, brewing and fermentation." At the same time the leaders were requested to maintain a high scientific standard by other studies and investigations, and it was expressly laid down that "No result of theoretical or practical importance may be kept secret." The work was to be supervised by a board consisting of three members of the Carlsberg Foundation representing natural sciences and two others, of which it is customary that one represent the Carlsberg breweries. The money allotted to the Carlsberg Laboratory was at first about $10,000 yearly and is now about $50,000.

The first leaders of the Carlsberg Laboratory were Johan Kjeldahl and Emil Chr. Hansen. Kjeldahl made his name a household word in chemical, biological and biotechnical laboratories all the world over by his method of nitrogen determination, and he made also very important studies of carbohydrate splitting enzymes. Hansen is chiefly known by his studies of yeasts leading to the adoption of pure strains of yeast derived from one single cell in the brewing and other industries. The successor of Kjeldahl was S. P. L. Sörensen, whose work on pH definition and determination is too well known to need any reference.

When Jacobsen died in 1887 the Carlsberg breweries were handed over to the Carlsberg Foundation and their income became available for the support of science, letters and art in Denmark, including the maintenance of the Carlsberg Laboratory. The benefits to science have been enormous and on the whole the arrangement has worked well, but I have grave doubts regarding the general wisdom of selecting by and from a body of scientists the leaders of a very large industrial undertaking.

The history of the Wellcome trust in England is in important respects very similar to that of the Carlsberg Foundation. The Wellcome Research Laboratories were established in the beginning of this century by the proprietor of the Burroughs Wellcome firm of manufacturing chemists to undertake medical research of a fundamental nature, and very important work was done under the leadership of Dale on the ergot alkaloids and on anaphylaxis. In 1924 the Wellcome

Foundation was established to take over the business and to keep up the different Wellcome laboratories and museums, and on the death of Sir Henry Wellcome in 1936 the whole estate was placed in trust for the benefit of medical science not only in England but in the world. I understand, however, that in this case the firm is carried on independently of the trust, which only disposes of the income.

This arrangement is somewhat similar in principle to another Danish experiment in cooperation between science and industry. Shortly after the discovery of insulin we undertook under a license from the University of Toronto the manufacture of insulin, primarily for the Scandinavian market, and arrangements were made to make this undertaking a public trust, the proceeds of which should be devoted to the furtherance of physiology and clinical endocrinology.

Under the leadership of Dr. Hagedorn the Nordisk Insulin Laboratory has grown into a fairly large concern, maintaining its own hospital for the study of endocrine disorders and fulfilling, I believe, an important function in keeping insulin prices in Europe at a comparatively low level. The surplus is handed over to the Scandinavian Insulin Foundation, composed of clinicians and physiologists from Denmark, Finland, Norway and Sweden, who distribute grants in aid of research. I think this a fair way of letting the exploitation of a scientific discovery help to further scientific research, but of course everything depends upon finding the right man to make such an undertaking a success.

With the inauguration of the Squibb Institute for Medical Research which we are dedicating to-day the firm of E. R. Squibb and Sons enters upon what constitutes in my opinion the highest level of cooperation between science and industry so far attained. In this case also a great deal depends upon finding the right man and I wish to express my confidence in my old friend, Dr. Harrop, who will be the leading spirit on the scientific side.

In the firm conviction that great benefit will accrue both to the firm, to the industry generally and to our beloved science I wish to express the gratitude of biology and to offer my heartfelt congratulations.

OBITUARY

RAYMOND H. TORREY

RAYMOND H. TORREY, one of the nation's leaders in the field of outdoor recreation and conservation, died at his home in Queens, Long Island, on July 15, 1938, upon his fifty-eighth birthday. Mr. Torrey was born in Georgetown, Massachusetts, and was a son of Captain Grafton F. Torrey, of Deer Island, Maine. He embarked upon a newspaper career at the age of sixteen and worked in Springfield, Massachusetts, until 1903, at which time he went to New York City to join the City News Association. At one time, he was night city editor of the *New York American* and the *New York Tribune*.

From the very beginning, Mr. Torrey showed a native interest in the out-of-doors and through the years gathered a great deal of information concerning history, geology and botany. At the time of his death, he was president of the New York Torrey Botanical Club and had become nationally known as an authority on lichens, having published a number of papers upon the subject, especially in the New York Torrey Botanical Club bulletins.

He was the organizer of the New York and New Jersey Trail Conference, and secretary of that conference for many years. He was also secretary of the Association for the Protection of the Adirondacks, secretary of the American Scenic and Historic Preservation Society and a member of the board of managers of the Appalachian Trail Conference, which organization directed the building and maintenance of the Appalachian Trail, a mountain footpath leading from Maine to Georgia. Mr. Torrey was also a former secretary of the New York State Council of Parks and former field secretary of the National Conference on State Parks. He was a member of the board of managers of the New York Botanical Garden, a member also of the American Museum of Natural History, the American Geographical Society, the American Association for the Advancement of Science, the Appalachian Mountain Club, the Green Mountain, Adirondack Mountain, Fresh Air and Tramp and Trail Clubs.

As field secretary of the National Conference on State Parks, Mr. Torrey traveled throughout America and reported upon the progress of parks in this country. His report entitled, "State Parks and Recreational Uses of State Forests," published by the conference in 1926, was one of the first comprehensive surveys of our park systems. As the principal author of "The New York Walk Book," together with Dr. Robert L. Dickinson and Mr. Frank Place, Mr. Torrey set before the people of metropolitan New York an outstanding compendium of recreational opportunities. The book has been reprinted several times and has been the means of informing countless citizens regarding various objectives along many trails.

Mr. Torrey's column, "The Long Brown Path," was published for many years in *The New York Post*. This newspaper column served to inform interested readers of opportunities to study botany, geology and zoology out-of-doors, and also helped them to realize the need for conservation wherever wilderness conditions remain. Mr. Torrey was a pioneer in locating and marking hiking trails in the eastern states. He also was responsible for placing large numbers of historical signs along the highways in the State of New York.

His friendly and kindly personality will be missed by many of his friends throughout the country. He was a man who believed firmly in his own convictions and who, in his last years, fought vigorously to prevent various agencies from despoiling our Eastern mountains with roads and other encroachments. He delighted in standing upon high places and looking toward far horizons and, better than this, he encouraged others to follow in his footsteps.

William H. Carr

RECENT DEATHS AND MEMORIALS

Dr. Addinell Hewson, professor emeritus of anatomy in the graduate school of medicine of the University of Pennsylvania and in the dental school of Temple University, died on October 27. He was eighty-three years old.

Sir Robert Ludwig Mond, British financier and industrialist, died on October 15 at the age of seventy-one years. Besides engaging in research in pure and applied chemistry, Sir Robert directed a series of explorations in Thebes, Palestine and Brittany.

Dr. R. G. Aitken writes that in his obituary notice of W. W. Campbell in the issue of Science for July 8, 1938, the date of his birth is given incorrectly. It should be April 11, 1862.

The Cornell Society of Engineers has presented to the university a portrait of the late Rolla C. Carpenter, formerly professor of experimental engineering. It is painted by Professor Olaf M. Brauner and will be one of the group of portraits of distinguished members of the department to be hung in the renovated Sibley Dome. Professor Carpenter joined the faculty as associate professor of experimental engineering in 1890.

SCIENTIFIC EVENTS

ACCOMMODATIONS FOR THE RICHMOND MEETING OF THE AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE

Recent correspondence indicates that there may be fears respecting accommodations for the approaching meeting of the association in Richmond, Va., which are not fully justified.

There are two aspects of the question of accommodations for meetings of the association, that of convenient rooms for the scientific sessions and that of guest rooms for individuals. A careful survey last January showed that in Richmond there are 79 rooms (24 having a seating capacity of more than 200 each) available for scientific sessions, the total seating capacity being 17,800. These 79 rooms are located in four rather compact groups, and hence it has been possible to schedule all the sessions of closely related sciences near one another. The greatest distance in walking time between any two rooms in any of the four groups is four minutes, and the greatest distance between any two groups is one and one-half miles. Each of the 79 rooms can readily be equipped for the use of a stereopticon. Moreover, the space available for the use of microscopes and for the showing of biological specimens is unusually commodious and satisfactory. Consequently, the accommodations for the scientific sessions are adequate and conveniently located. In fact, few cities can provide so many good meeting rooms in so small an area.

When it comes to guest rooms for visiting scientists the conditions are not so favorable, but they are far from being seriously unfavorable. In Richmond there are seven first-class and five second-class hotels, in addition to excellent rooms, each with a bath, in the dormitory of the Medical School, and there are other possibilities. It should be noted at once that the hotels in Richmond are doing everything within their power to provide the association and its affiliated societies with adequate accommodations. All the rooms for scientific sessions and for committee meetings are provided without charge. The rates for guest rooms in no case have been increased. Of course, the Richmond hotels, like those in all other cities, have rooms at various levels of prices depending on their size and furnishings. Naturally not every person can secure the minimum rate in the hotel he chooses. The Jefferson Hotel, which was built before the days of severe economies in space, has a considerable number of unusually large combination bedrooms and sitting rooms which, of course, are not available at minimum rates, but in which two or more friends can obtain excellent accommodations at a very moderate cost to each.

All the Richmond hotels are cooperating fully in providing the maximum capacity at the lowest possible cost to guests. In addition, there is a local committee on housing, of which the chairman is Mr. Foley F. Smith, A.B.C. Laboratory, Richmond, Va., to which every person having difficulties in securing accommodations should write, stating his requirements.

Hotels in Richmond

Jefferson. With bath: Single, $3 to $3.50; double, $5 to $8. Without bath: Single, $2 to $4.

John Marshall. With bath: Single, $3 to $5; double, $5 to $8.

Murphy. With bath: Double, $3.50 to $6. Without bath: Single, $2.50 to $3; double, $3.

Murphy Annex. Without bath: Single, $1.50; double, $2.50.

Richmond. With bath: Single, $2.50 to $3.50; double, $5 to $7. Without bath: Single, $1.50 to $2; double, $3.50.

Rueger. With bath: Single, $2.25 and up; double, $3.75 to $5. Without bath: Single, $1.75 and up; double, $3 to $3.50.

Capitol. With bath; Single, $2 to $2.50; double, $2.50 to $3.50. Without bath: Single, $1.25 to $1.50; double, $2.00 to $2.50.

William Byrd. With bath: Single, $2.50 to $4.50; double, $4 to $7. Without bath: Single, $2 to $2.50; double, $3 to $4.

Travelers. With bath: Single, $1.50 to $2; double, $2.50 to $3.

Sharlee. With bath: Double, $1.50 and up. Without bath: Single, $1; double, $1.50 and up.

Gilbert. With bath: Single, $1.50 and up. Without bath: Single, $1 and up.

Connell & Miller. With connecting bath: Single, $1.25 and up; double, $2.

Walford (Y.W.C.A.). With running water: Single, $1 to $1.50; double, $2.50. With bath: Double, $2.50.

In addition to the hotels there are excellent tourist homes, most of which are new houses, in which rooms may be secured through Mr. Smith's committee at from $1.00 to $2.00 per day. These tourist homes are on the principal boulevards within twenty minutes by frequent bus service from all meeting places of sections and affiliated societies.

As has been stated, the rooms available at Richmond for the scientific sessions are abundant and within easy reach of one another. Although the hotel accommodations may fall short of all requirements, it is not likely that any one having a little patience will suffer serious inconvenience. The housing committee will have an information desk at the Headquarters in the Mosque and in all principal hotels with lists of all available accommodations and will assist those who have not made arrangements for rooms before arriving in Richmond.

F. R. Moulton,
Permanent Secretary

PRIVATE LANDS IN THE LASSEN VOLCANIC NATIONAL PARK

Prohibition against hunting on private lands embraced within the limits of Lassen Volcanic National Park has been upheld in an opinion by Frederick L. Kirgis, acting solicitor of the U. S. Department of the Interior, and approved by the Assistant Secretary of the Interior, Oscar L. Chapman.

Secretary of the Interior Harold L. Ickes had asked for an opinion to clear up questions raised by an opinion of the attorney general of California as to the effect of National Park Service regulations in respect to privately owned lands in the park.

The state attorney general had held that the state game and fish wardens had jurisdiction over the privately owned lands in the park area when a question came up regarding measures taken by the federal park rangers to prevent hunting and other threatened disregard of the strict Park Service regulations.

Exclusive jurisdiction over the entire park area, whether privately owned or land to which the Federal Government has title, now will be assumed by the United States Commissioner for the park, and the Park Service authorities and rangers.

In support of the opinion, there was cited the Act of 1916 creating Lassen Volcanic National Park which had dedicated the entire area within the described boundaries, together with the California act ceding jurisdiction to the Federal Government. The acting solicitor said regarding the description of the area in the California act:

> The description did not exclude isolated tracts held in private ownership. The words of the California act ceding jurisdiction over the territory within the tract of land set aside and dedicated for park purposes by the United States as Lassen Volcanic National Park, constitute simply a description of the territory to which the act refers, not a restriction of the jurisdiction of the United States within the territory.

Calling attention to a later act of the Congress in 1928, by which the United States assumed sole and exclusive jurisdiction over the park, the opinion continued:

> The effect of both acts read together is that the United States has sole and exclusive jurisdiction over all the park, including privately owned lands, but such privately owned lands within the park are not dedicated to the use of the public. They can be enjoyed by the private owners and the general public has no right to encroach thereon. But the lands are entirely under the jurisdiction of the United States, except for the matters reserved by California in the act of cession. The owners of the lands must obey United States laws. California laws, except those relating to process serving, taxation and voting, are absolutely inoperative within the park.

The opinion quoted a provision of the original act of 1916 creating the park to the effect that no lands within the park boundaries held in private, municipal or state ownership should be affected by the provisions of the act. But the opinion held that this provision merely negatived the conclusion, which otherwise might be drawn, that private lands, as well as public lands, were dedicated to public purposes. Attention was called to the fact that this provision was not contained in the Act of 1928.

The opinion relied also on decisions of the United States Supreme Court, which "has consistently held that a cession by a state to the United States of exclusive jurisdiction over a tract of land put the tract beyond the field of operation of all state laws except as to matters specifically reserved."

A SECOND SUPPLEMENT TO THE UNITED STATES PHARMACOPOEIA

AT the recent meeting of the United States Pharmacopoeia Board of Trustees authority was given for the publication of the second United States Pharmacopoeia XI supplement. It is hoped that this can be issued on January 1, 1939.

Preparation has been under way for months, and subcommittee chairmen will be in a position in the near future to submit reports on a number of revised texts. The subcommittee on scope is also considering the admission of a number of additional important new drugs.

The members of the committee are fully familiar with the outstanding advantages of the interim revision and supplement features of the Pharmacopoeial program. This gives the opportunity to issue new standards after they have been subjected to extensive checking in many laboratories.

The Pharmacopoeia Board or Committee of Revision are responsible only for the preparation of the official standards. Whether or not the Pharmacopoeia and its supplements are purchased by retail pharmacists is, in some states, entirely optional. In other states where the state law requires the possession of these books, it is a matter for the responsible state officials to enforce.

Finances are reported to be in excellent condition, and the Board of Trustees has been able to meet the revision expenses of the decade, to increase greatly the research and conference programs, and still to hold its basic reserves intact.

In preparing the second supplement, every step will be taken to insure the carrying out of the requirements of the convention for the preparation of an official text. It is expected that the revised or new monographs will be submitted in the form of proof to members of the committee of revision and given wide publicity. Following their publication, a public hearing will be granted at which members of the executive committee responsible for revised texts will be in attendance. Following the public hearing a conference with the officials of the Food and Drug Administration and the Public Health Service will be held, after which the members of the committee of revision will be given an opportunity to see and vote upon the finally approved text. When the supplement has been issued, ample time will be given before it becomes official.

AWARD OF THE WILLIAM H. NICHOLS MEDAL OF THE NEW YORK SECTION OF THE AMERICAN CHEMICAL SOCIETY

THE William H. Nichols Medal of the New York Section of the American Chemical Society has been awarded for 1939 to Dr. Joel Henry Hildebrand, professor of chemistry in the University of California.

Professor Hildebrand has pursued investigations in every field of general, physical and analytical chemistry, including such diverse questions as the vapor pressure of metal amalgams and the use of helium in preventing caisson disease, the "bends" of tunnel and caisson workers and of deep-sea divers. He was cited by the jury specifically for his study of the fundamental thermodynamic and kinetic properties of liquid and solid solutions, a field in which he is preeminent. The statement made by the jury reads:

> Professor Hildebrand is internationally respected for his contributions over many years concerning the experimental properties and theoretical aspects of substances when in the liquid or molten state. This work includes the study of mixtures of such common solvents as water, alcohol, carbon tetrachloride, chloroform and the petroleum solvents with iodine, sulfur, naphthalene, anthracene and a hundred other solids; mixtures of the solid metals with the one common liquid metal, mercury, and mixtures of solid and molten salts, like ordinary table salt, saltpeter, silver chloride, etc., with each other.
>
> He has succeeded in classifying these solutions, correlating their behavior, finding their peculiarities and deriving theoretical and mathematical relations concerning them so that their properties are known or may be predicted in a way previously impossible.
>
> In recent years, Professor Hildebrand has devoted more and more attention to the exceedingly abstruse but nevertheless fundamental theoretical problem of the intermolecular forces in liquids and liquid mixtures. If the scientist knew the exact nature of the electrical, gravitational and chemical forces exerted by each ultimate particle of matter—the molecule—on its neighboring molecules, he would be in a position to declare positively how any pure liquid or any mixture would behave.
>
> If molecules were small, hard balls, with only gravitational forces at work, their distribution in a solution would be as simple as that of a mixture of black and white marbles shaken together and poured into a vessel. But molecules are composed of positive electrically charged atomic nuclei and negative electrons, with empty space, penetrated only by these electrical forces, accounting for a large part of their volume. The forces acting between adjacent particles vary from the intense electrical attraction and repulsion of charge ions to the much smaller forces between symmetrical molecules whose electric charges are all neutralized within the structure of the

particle. Professor Hildebrand's studies in this field have led to many valuable publications in scientific journals in recent years. He is a master of the problems of solubility and solution in general.

Professor Hildebrand will receive the medal at a dinner of the New York Section on March 10, at which time he will speak on "The Solubility of Non-Electrolytes."

SCIENTIFIC NOTES AND NEWS

SIR WILLIAM BRAGG, director of the Royal Institution of Great Britain and president of the Royal Society, has been appointed to give the first Pilgrim Trust lecture at the April meeting of the National Academy of Sciences. As has already been announced, Dr. Irving Langmuir, of the Research Laboratories of the General Electric Company, will give the corresponding lecture in London on December 28. The Pilgrim Trust, established in England by Edward S. Harkness, provides funds for the exchange of lecturers on alternate years between the National Academy of Sciences and the Royal Society.

A NEURO-PSYCHIATRIC clinic building for the State Hospital for Mental Diseases at Providence, R. I., has been named for Dr. Adolf Meyer, Henry Phipps professor of psychiatry at the Johns Hopkins University School of Medicine. To mark the occasion a testimonial dinner was tendered to Dr. Meyer at the University Club, which was attended by a distinguished group of psychiatrists and neurologists. Dr. Meyer was characterized as "a wise, scientific leader of psychiatry, who has piloted the bark of this developing branch of medicine through its years of growth . . . avoiding the many pitfalls of new cults . . . always searching for scientific truth."

THE *Journal* of the American Medical Association reports that the Richmond Academy of Medicine gave on September 27 an informal testimonial dinner in honor of Dr. Stuart McGuire, emeritus professor of surgery at the Medical College of Virginia, in appreciation of his interest in and devotion to the academy. A portrait was presented to the academy on behalf of a group of donors by Dr. Roshier W. Miller. Dr. John M. T. Finney, emeritus professor of surgery at the School of Medicine of the Johns Hopkins University, was the principal speaker.

THE University of California Press announces the appearance of the volume prepared in honor of Dr. Alfred Louis Kroeber, who was for thirty-five years a member of the department of anthropology in the university. It contains thirty-six essays, on a variety of anthropological subjects, from writers in this country and from abroad, contributed "in appreciation of the scholar and in affection for the man." There is also a chapter of personal reminiscences and professional appreciation, and a list of Professor Kroeber's published writings to the present year.

AT the annual dinner on October 19 of the Congress of Anesthetists, meeting in New York City, silver plaques were awarded, in recognition of their work in "making Bellevue Hospital a world center in the research and development of anesthesia," to Dr. S. S. Goldwater, commissioner of hospitals; to Dr. Arthur M. Wright, professor of surgery, New York University; to Dr. E. A. Rovenstine, professor and director of anesthesia, New York University, and to William F. Jacobs, superintendent of Bellevue Hospital. A silver plaque was presented also to Dr. John S. Lundy, of the Mayo Clinic, Rochester, Minn., founder and editor of *Anesthesia Abstracts*. Loving cups were presented to Dr. Paul M. Wood, of Columbia University, for work in anesthesia and to Dr. Juan White-Morquecho, of the University of Mexico, for his work in the development of anesthesia in Mexico.

PRESENTATION of the gold medal of the Royal Aeronautical Society of Great Britain was made by Sir Neville Henderson, the British ambassador to Germany, to Dr. Hugo Eckener at a dinner given in Berlin on October 12 by Field-Marshal Göring for the German and foreign delegates to the annual Congress of the Lilienthal Society for Aeronautical Research. The British ambassador stated that it was the first time that the gold medal of the Royal Aeronautical Society had been awarded outside the British Empire.

DEAN JULIAN PARK, of the University of Buffalo, has sailed for France to receive the degree of doctor *honoris causa* from the University of Dijon. He will also represent Buffalo at the meeting in commemoration of the discovery of radium and x-rays to be held at the Sorbonne on November 23.

THE National Association of Science Writers has elected Leonard Engle, Science Service, Washington, D. C., and Wesley Fuller, Cambridge, Mass., to active membership. J. G. Crowther, London, has been elected to associate membership.

THE University of St. Andrews, at the annual autumn graduation ceremony, conferred the honorary degree of LL.D. on Sir Gilbert Thomas Morgan, director of chemical research in the National Physical Laboratory, Teddington.

IN recognition of his "distinguished contributions to science," the University of Halle-Wittenberg has conferred the honorary degree of doctor of natural sciences upon Professor E. C. Stakman, head of the section of plant pathology at University Farm, University of Minnesota. Representing the University of Halle-Wittenberg in the presentation ceremonies which took place at a luncheon at University Farm recently, was P. von Stolzmann, acting consul-general for Germany, with headquarters at Chicago.

Dr. Albert C. Snell, of the School of Medicine of the University of Rochester, was named president-elect of the American Academy of Ophthalmology and Otolaryngology at the recent Washington meeting. He will succeed Dr. George M. Coates, of Philadelphia. Three vice-presidents were elected: Drs. William W. Pearson, Des Moines; William J. Mellinger, Santa Barbara, and Charles A. Bahn, New Orleans.

The Academy of Physical Medicine, meeting in Washington, D. C., elected on October 26 the following officers: *President,* Harold D. Corbusier, of Plainfield, N. J.; *First Vice-president,* Dr. Fred H. Albee, New York, and *Secretary-Treasurer,* Dr. Herman A. Osgood, Boston.

Frank Malcolm Farmer, vice-president of the Electrical Testing Laboratories, New York, has been reelected chairman of the research procedure committee of the Engineering Foundation for 1938–39. George E. Beggs, professor of civil engineering at Princeton University, was elected vice-chairman. J. H. R. Arms will continue as secretary and Otis E. Hovey as director.

Walter H. Parker, professor of mining in the School of Mines and Metallurgy of the University of Minnesota, has been elected a member of the British Institution of Mining and Metallurgy.

The title emeritus has been conferred by the University of Missouri on Dr. C. W. Greene, since 1900 professor of physiology and pharmacology.

Dr. Harry B. van Dyke, head of the pharmacological division of the Squibb Institute for Medical Research, has been appointed honorary professor of physiology in the College of Arts and Sciences of Rutgers University. He will serve also as research consultant in the Bureau of Biological Research.

Dr. Harley J. Van Cleave, professor of zoology in the University of Illinois, has been appointed acting head of the department. Dr. Herman B. Chase, until recently associated with the Roscoe B. Jackson Memorial Laboratory at Bar Harbor, Me., has become an instructor in zoology.

Associate Professor P. Gerald Kruger is acting head of the deparment of physics of the University of Illinois for the first semester. He takes the place of Professor F. W. Loomis, who has leave of absence, which he is spending in Europe.

Dr. Andrew van Hook, of the department of chemical engineering at Lafayette College, has become assistant professor of chemical engineering at the University of Idaho.

Dr. Robert T. Hance, professor of zoology in the University of Pittsburgh, has leave of absence for the current academic year. He has accepted an invitation to spend the year as guest professor of biology in the Graduate School of Duquesne University in Pittsburgh.

Dr. Irene Levis, formerly in charge of the micro-analytical laboratory of the University of Frankfort, Germany, has been placed in charge of a micro-analytical laboratory to be established at the Case School of Applied Science. She will also give a course in micro-analysis to graduate students.

Dr. Mary Juhn, research associate in the Whitman Biological Laboratories of the University of Chicago, has been appointed research associate professor in the poultry department of the University of Maryland.

Emma F. Sirrine, associate botanist of the Division of Seed Investigations of the U. S. Department of Agriculture, has retired after serving for thirty-three years.

Dr. Charles W. Rees, formerly associate zoologist, has been promoted to the post of zoologist in charge of the project investigations of Protozoan parasites of domestic animals, in the Zoological Division of the Bureau of Animal Industry, of the U. S. Department of Agriculture, at Beltsville, Md.

Dr. Lee E. Yeager, recently of the Division of Forest Insects of the Bureau of Entomology and Plant Quarantine, U. S. Department of Agriculture, has been appointed forester at the Illinois Natural History Survey at Urbana.

Dr. C. E. ZoBell, of the Scripps Institution of Oceanography, has been given a post-graduate fellowship at the University of Wisconsin, where he will be visiting professor in the department of limnological microbiology. Dr. D. L. Fox has been awarded a Rockefeller Foundation research fellowship. He will work at the School of Biochemistry of the University of Cambridge, England. Both have been granted sabbatical leave for a year. On the basis of work conducted at the institution, Dr. E. H. Myers, of Compton Junior College, has been awarded a Guggenheim fellowship. The fellowship accepted by Dr. ZoBell provides a stipend for a visiting professor during the year, together with the salary of a research assistant. The fellowship awarded to Dr. Fox provides a stipend, research fees and travel expenses to enable him to continue his work on the carotenoid pigments of animals. Dr. Myers is working on foraminifera at the Marine Biological Laboratory, Plymouth, England.

The British Medical Research Council has appointed Sir Henry Bashford, chief medical officer of the General Post Office, and Sir Kenneth Lee, chairman of Tootal Broadhurst Lee Company, to fill vacancies in the membership of the Industrial Health Research Board.

Dr. August Krogh, professor of animal physiology at the University of Copenhagen, has been appointed lecturer for 1939 of the Cooper Foundation of Swarthmore College. He will give the lectures on the "Comparative Physiology of Respiratory Mechanisms" on March 16 and 23 and on April 6, 13 and 20.

Dr. Charles H. Best, professor of physiology at the University of Toronto, addressed a joint meeting of the Institute of Medicine of Chicago and the Chicago Society of Internal Medicine on October 28. He spoke on "Heparin and Thrombosis."

The second W. E. Dixon Memorial Lecture of the Royal Society of Medicine was delivered by Sir Frederick Banting at a meeting of the Section of Therapeutics and Pharmacology on October 11. The subject of his lecture was "The Immunity Aspect of the Tumor Problem."

Sir James Jeans delivered on October 8 the Lorimer Lecture of the Astronomical Society of Edinburgh. His address was entitled "The Depths of Space."

The Institute of Medicine of Chicago announces that its fifteenth Pasteur Lecture will be given in conjunction with the Cancer Research Institute of the Chicago Woman's Club at a public meeting to be held on Tuesday evening, November 22, at eight fifteen o'clock in the auditorium of the museum of Science and Industry. Dr. Ludvig Hektoen, director of the John McCormick Institute for Infectious Diseases, Chicago, and of the National Advisory Cancer Council, Washington, D. C., will speak on "Progress in the Knowledge and Control of Cancer." A reception in honor of Dr. and Mrs. Hektoen will follow the lecture and, through the courtesy of the Museum of Science and Industry, the medical exhibits will be open.

The new science building of Bryn Mawr College, which houses the departments of geology and chemistry, was formally opened on October 22. The principal address was made by Dr. Norman L. Bowen, professor of petrology at the University of Chicago. Other speakers were Dr. Florence L. Bascom, professor emeritus of geology at Bryn Mawr College, and Dr. Louis F. Fieser, of the department of chemistry of Harvard University, who formerly was a professor at the college. President Marion Edwards Park presided at the dedication.

DISCUSSION

GOVERNMENTAL SUPPORT OF RESEARCH IN FRANCE

The following abstract translated from an article in "Réalités Françaises" for May, 1938, on the gradual development of the organization and financing of research in France is of interest at the present time when increased government support has been urged in this country.

Arthur J. Dempster

University of Chicago

In the past, scientific research in France received very little official support and the situation became more and more critical as the successful prosecution of scientific investigations required greater and greater expenditures for equipment. While, for example, Pasteur's apparatus could be purchased for very little, the "cyclotron" constructed for Frédéric Joliot involved an expenditure of 2,000,000 francs.

The "Caisse des Recherches Scientifique," which was created after the war, with a budget of 2 million francs, proved inadequate to support publications and the purchase of apparatus.

A new effort was made in 1924. As member of the chamber of deputies, Emil Borel, the well-known mathematician, proposed that the proceeds from a special tax should be devoted to the support of scientific laboratories. It was realized, however, that in addition to providing apparatus, it was just as important to recruit investigators and create positions where they could work free of material cares.

Up till the last few years, scientific research was centered in the universities; this, though excellent, did not make full use of the intellectual resources of the country. For the best results, it was essential to organize laboratories where instruction should not play the predominant role.

As early as 1921, Edmond de Rothschild, impressed by the important part played by scientific technique during the war, had created a foundation of 10,000,000 francs designed to provide fellowships for young investigators in subjects related to industry and national defence. The chemist, André Job, persuaded him to devote the proceeds of this endowment rather to the support of fellows in pure science, in order to complete the existing "service fellowships" in the universities, which alone were available at that time, and which did not leave a student free for scientific work. The new fellowships thus created made possible among many others the early investigations of Frédéric Joliot. Intrigued by Claude Bernard's dictum that the mechanism of life might be elucidated by the study of physical-chemical phenomena, Edmond de Rothschild went further and created an enlarged endowment of 50,000,000 francs for an institute where physicists, chemists and biologists, working together, might attack this problem. Four scientists, Jean Perrin, Pierre Gérard, André Job and André Meyer, formed the permanent committee of this institute. Enlarging the original plan, a regular research organization was proposed. Four grades corresponding to university positions were planned: Boursiers (fellows), chargés de recherches, maîtres de recherches and directeurs de recherches, which would permit a man to devote himself to scientific research without giving part of his time to instruction.

THE "CONSEIL SUPERIEUR DE LA RECHERCHE"

To select the personnel and direct the expenditure, it was decided on the suggestion of Jean Perrin to form a committee of eminent scientists representing all the main branches of science, who would be willing to devote themselves to these tasks without remuneration. The proposed annual budget required by this scheme was estimated at 40,000,000 francs, of which 20,000,000 would be devoted to paying the salaries of the workers and 20,000,000 to defraying the cost of equipment. In June, 1930, Edouard Herriot, convinced by Perrin of the importance of such an organization for the national defense, asked for an appropriation from the chamber of 20,000,000 francs. An annual appropriation of 5,000,000 francs was granted and the "Caisse Nationale des Sciences" was set up. In 1931, research fellows were appointed and a committee was set up which was divided into subcommittees of ten to twelve members for each of the main branches of science. In 1933, the "Conseil Superieur de la Recherche" finally came into being.

The various sections during the first year appointed more than 200 investigators, and the 5,000,000 francs were found quite insufficient. Its appropriation was then increased to 7,500,000 francs, with the understanding that one sixth of this sum should be devoted to the humanities. In 1935, the laws in connection with the devaluation of the franc resulted in a reduction of the budget by 25 per cent. and abolished the special tax devised by Emil Borel. However, the period of difficulty was followed in 1936 by the appointment of Irène Curie-Joliot to the newly created office of undersecretary for scientific research in the government of Léon Blum. For the first time in the world, the claims of science as an essential national activity could have direct access to a government. After a few months, Irène Curie-Joliot was succeeded by J. Perrin, and the annual budget was increased from 11,500,000 to 26,500,000 francs. In 1937, thanks to the support of the minister of national education, Jean Zay, the budget was increased to 32,500,000 francs. To insure a stable organization and at the same time avoid every tendency to excessive bureaucracy, scientific directors have replaced civil service officials wherever possible.

Among the projects undertaken by the organization may be listed: the observatory for astrophysics at Forcalquier; the national chemical institute now being built at Ivry, the laboratory for atomic transformations which is a development of the laboratory of Joliot at the Collège de France, the laboratory for low temperature research at Bellevue, and in quite a different field, an "Institut des Textes." It also arranged the science exhibits at the International Exposition of 1937.

To be sure, the present annual budget of approximately 32,500,000 francs does not enlist in the service of science more than a small part of the native talent; however, the rapid increase in the budget in recent years marks a fundamental change of attitude. In France, the old belief has vanished that a true scientist lives in poverty and does marvels with makeshift equipment.

CYTOARCHITECTURE OF THE GORILLA BRAIN

THE late Alfred W. Campbell (1868–1937) made one of the first, and certainly the most adequate, comparative study of cytoarchitecture of the anthropoid cortex. His well-known book, "Histological Studies on the Localisation of Cerebral Function" (1905), was based upon brains of the chimpanzee and the orang which had been supplied to him by Sherrington and Grünbaum. He had not had opportunity at this time to take up the gorilla, and since it is generally believed that the cytoarchitecture of the gorilla brain has never been studied, it seems worth while to direct attention to a little-known paper on the subject published by Campbell in 1916 after he returned to Australia. In it, incidentally he modified his earlier views on the olfactory fields. The reference is as follows:

> ALFRED W. CAMPBELL. ''Histological Studies on the Localisation of Cerebral Function. The Brain of the Gorilla.'' *Reports from the Pathological Laboratory of the Lunacy Department, New South Wales Government*, 3: 20–35, 1916.

A copy of this report has just been sent to the writer of this note by the inspector-general of mental hospitals at Sydney, and I shall be glad to make it available through photographic reproduction to any student of cytoarchitecture. The entire hemisphere was analyzed, and the paper is illustrated with five excellent plates. Campbell's first paragraph reads as follows:

> In my work on the localisation of cerebral function, published in the year 1905, it formed part of my task to compare the cortex cerebri of homo with that of two members of the anthropoid ape family, namely, the chimpanzee (*anthropopithecus troglodytes*) and the orang-outang (*simia satyrus*). Through the kindness of Professor C. S. Sherrington, of Liverpool University, I have since been provided with the right cerebral hemisphere of a gorilla (*anthropopithecus gorilla**), which I have examined on lines similar to those followed in the original investigation, and as such specimens are difficult to obtain, and I believe this is the first to be submitted to such examination, I am prompted to offer the following report and ask that it be taken as an addendum to what I have already written.
>
> * The animal was young, almost a baby, accordingly the myelinisation of the cortical nerve fibres was incomplete and imperfectly developed nerve cells (neuroblasts), especially in the deeper parts, were abundant. But, although the specimen differed in this way from those of the other apes examined, the determination of the various areas in which we are interested was not interfered with.

Dr. T. C. Ruch, whose forthcoming bibliography of all primate literature is being made ready for press, informs me that Campbell's study of the gorilla brain is the only complete survey in the literature. An account of Campbell's life will be found in the *Archives of Neurology and Psychiatry*, 40: 566–568, 1938.

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OCCURRENCE OF THE ORIENTAL RAT FLEA IN THE INTERIOR OF THE UNITED STATES

The oriental rat flea, *Xenopsylla cheopis* (Rothschild), which is the chief transmitter of bubonic plague to man, was first reported from the interior of the United States by Roudabush and Becker.[1] They took many specimens of this flea during the year 1934 from rats shot on the dumping grounds of the city of Ames, Iowa. Next it was reported from the Middle West by Owen,[2] who found a dairy barn at the University of Minnesota Farm, St. Paul, heavily infested. The present writers now report the occurrence of this flea from two additional mid-western states, Illinois and Ohio.

Among the fleas in the collection of the Illinois State Natural History Survey were found eleven females and six males of *Xenopsylla cheopis*, which were taken by M. D. Farrar at Urbana, Illinois, on December 1, 1937, in elevator refuse. The Ohio record is based upon three females and three males sent in for identification from Youngstown, Ohio. They were taken in an office on August 10, 1938, by E. A. Berglund, and were reported to be biting men and causing considerable discomfort.

Opinion has held that this tropical rat flea can not flourish in temperate climates. Its presence for years in large numbers in the warmer port cities of the United States without being recorded from the interior of our country would appear to have justified such a conclusion. However, being now known from four of our central states, Iowa, Minnesota, Illinois and Ohio, a revision of such an opinion appears to be necessary. There is a possibility that a more resistant race of this flea has been developed in some of our northern ports, such as New York and Boston, and from there has spread to the Central States.

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[1] R. L. Roudabush and E. R. Becker, Science, 80: 97, 1934.

[2] W. B. Owen, *Jour. Parasitology*, 22: 512, 1936.

SCORPION STINGS

I have read with much interest the contribution by H. L. Stahnke on "The Venomous Effects of Some Arizona Scorpions" in the issue of August 19. A brief account of personal experience may have interest.

About 20 years ago I was stung on the top of my right foot, just at the base of the little toe, at about 10 o'clock at night. A small red spot appeared and pain began promptly, increased in volume, and soon the entire foot seemed to ache. There was only slight swelling then or later. The pain gradually diminished during the following day.

The most pronounced effect was what appeared to be a nervous reaction. As I naturally am a heavy sleeper and was tired physically, I do not know what happened during the night. The next morning, however, the tips of my fingers, toes and ears and the point of my nose and my chin throbbed and twitched noticeably. There was a slight itching sensation and also somewhat the same feeling that a foot has after being "asleep."

The twitching was a definite muscular reaction, and the extremities actually moved spasmodically. This continued during the first day but gradually diminished during the course of the second day after the stinging.

After the attack, the scorpion retreated into a deep crevice in an unfinished portion of the room and could be seen but not captured. It appeared to be about 3½ inches long. This occurred at the Federal Plant Industry Field Station near San Antonio, Texas.

It should be noted that I am markedly resistant to some poisons. I am practically immune from poison ivy infection, very resistant to local anesthetics and but little troubled by mosquitoes and fleas or flies. On the other hand, I am susceptible to nettle stings and very susceptible to "chigger" bites if preventive treatments are not employed. I have never been bitten by poisonous snakes, tarantulas or spiders, nor stung by bees or hornets, although prowling out of doors most of my life.

Carleton R. Ball

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QUOTATIONS

THE SCIENTIFIC MONTHLY AND THE AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE

At the April, 1925, meeting of the executive committee of the council of the American Association for the Advancement of Science, the editor and owner of Science offered under certain conditions to let the journal, which since 1900 had been the official organ of the association, become its absolute property. The plan was approved by the executive committee, which unanimously voted "its sincere and hearty thanks to Dr. Cattell for his most generous offer." The agreement was put in contractual form by Dr. Roscoe Pound, dean of the Harvard Law School, one of the distinguished fellows of the association, originally elected for his contributions to botany. The contract was executed by the owner of Science and Dr. Pupin, president of the association, and attested by Dr. Livingston, permanent secretary, on July 28, 1925. It was approved by a unanimous vote of the council of the association on December 30, and a committee, consisting of Drs. Pupin, Kellogg and Livingston, was appointed to express to Dr. Cattell the appreciative thanks of the association.

At the annual meeting of the association held in Atlantic City in December, 1936, a similar offer was made in regard to *The Scientific Monthly,* which has been an official journal of the association since 1907 to the extent that it may be received by members in place of Science. The offer was referred to a subcommittee consisting of Professor Edwin G. Conklin, president of the association; Professor George D. Birkhoff, president-elect, and Professor Burton E. Livingston, formerly permanent secretary. This committee reported to the executive committee meeting in New York in April, 1937, as follows:

> The subcommittee is unanimously agreed that Dr. Cattell's proposal is a very generous one and that it will be of much present value to the association and may in the future become of still greater value. We, therefore, recommend that it be adopted with hearty thanks and that the President and Permanent Secretary of the Association be authorized and directed to take such steps as may be necessary therefor and to enter into and to execute a contract for this transfer of *The Scientific Monthly* from its present owner to the American Association for the Advancement of Science, in conformity with the terms of the proposal of Dr. Cattell dated December 25, 1936, and that this action be reported to the council at the Denver meeting. We also wish to express to Dr. and Mrs. Cattell our sincere appreciation of their great and long-continued services to scientific organization, cooperation and progress.

This report was unanimously approved by the executive committee and was reported to the council at the Denver meeting. In view of this action it was decided last spring to let *The Scientific Monthly* be edited at the Washington office of the association, and Dr. F. R. Moulton, permanent secretary of the association, and the late Dr. Earl B. McKinley, member of the executive committee, agreed to join in the editorship, Ware Cattell remaining as associate editor. Manuscripts and other editorial communications should now be sent to The Editors of *The Scientific Monthly,* Smithsonian Institution Building, Washington, D. C.

The Scientific Monthly, then named *The Popular Science Monthly,* was established by J. W. Youmans and the firm of D. Appleton and Company in 1872. In its earlier years organic evolution and natural selection excited controversy and wide public interest; the journal attained much influence and a relatively large circulation. The Appletons published in the United States the works of many British men of science and were able to print in the *Monthly* articles by Darwin, Spencer, Huxley, Tyndall and other leaders. After the death of the elder Youmans and the development of more technical work in science the journal became unprofitable, having been conducted for a time at an annual loss of about $10,000. It was then sold to the present owner and editor.

The transfer of the journal to the American Association, combined with efficient editorship, should give the country a better journal of general science than it has ever before had. It should greatly increase the membership of the association and have the cooperation of all workers in science. There will be no change in editorial policy, but an endeavor will be made to make the journal not only authoritative, as it has always been, but of greater interest to those educated people who wish to follow the advances and share the spirit of science, the dominant factors in modern civilization.

The undertaking will be much more difficult without McKinley, who was admirably fitted for the editorship of a journal such as *The Scientific Monthly.* His loss with the ill-fated Hawaii Clipper, while collecting germs in the upper air for his studies on the distribution of disease, was a disaster to science the magnitude of which can only be appreciated by those who have worked with him. He was dean of the Medical School of the George Washington University and was engaged in scientific work of originality and importance. In addition to these engagements he devoted a considerable part of his time and unlimited energy to scientific organization. In recent years he has taken a leading part in the work of the American Association for the Advancement of Science and for it his loss is irreparable. As one of the editors of *The Scientific Monthly* he would surely have had the usefulness and the success that attended all his enterprises. McKinley had genius for scientific research, organization and administration; most of all, for friendship. There is none like him, none, nor will be.

J. McK. C.

SOCIETIES AND MEETINGS

THE SEMICENTENNIAL CELEBRATION OF THE AMERICAN MATHEMATICAL SOCIETY

In recognition of the fiftieth anniversary of its founding as the New York Mathematical Society, the American Mathematical Society arranged for its summer meeting this year not only a scientific program of unusual interest, but a jubilee celebration of significance. The meetings were held from September 6 to 9, at Columbia University.

Preceded by seven sectional meetings, at which over one hundred research papers were communicated, the scientific part of the anniversary observance consisted of ten invited addresses reviewing aspects of the development of mathematics during the past fifty years and pointing out some of the indications for progress in the future. The speakers and their topics were as follows:

R. C. Archibald, Brown University, "History of the American Mathematical Society, 1888–1938."

G. D. Birkhoff, Harvard University, "Fifty Years of American Mathematics."

E. T. Bell, California Institute of Technology, "Fifty Years of Algebra in America, 1888–1938."

G. C. Evans, University of California, "Dirichlet Problems."

E. J. McShane, University of Virginia, "Recent Developments in the Calculus of Variations."

J. F. Ritt, Columbia University, "Algebraic Aspects of the Theory of Differential Equations."

J. L. Synge, University of Toronto, "Hydrodynamical Stability."

T. Y. Thomas, University of California at Los Angeles, "Recent Trends in Geometry." (Read by Mr. J. F. Daly, of Princeton University.)

Norbert Wiener, Massachusetts Institute of Technology, "The Historical Background of Harmonic Analysis."

R. L. Wilder, University of Michigan, "The Sphere in Topology."

These addresses, except that by Professor Archibald, have been published by the society under the title of "Semicentennial Addresses," as Volume II of its Semicentennial Publications. Volume I is a history of the society written by Professor Archibald and containing in greatly amplified form the material of his lecture. The fact that these volumes were in print and ready for distribution at the time of the meeting added not a little to the import of the addresses as part of an anniversary celebration.

Several scientific exhibits dealing with the history, teaching and applications of mathematics were arranged by Columbia University and members of its faculty; these also added greatly to the celebration.

The features of the meeting more closely related to the jubilee were introduced by a reception tendered by Columbia University to the visiting mathematicians, who were received by President and Mrs. Nicholas Murray Butler. Immediately following the reception, a convocation of the society was held, at which delegates from sister organizations were introduced, and letters of greeting and felicitation presented. This gathering also afforded an occasion for the society to voice its gratitude to Columbia University for its hospitality and patronage during the half-century, for the American Mathematical Society was founded at Columbia, by Columbia men; over half of its regular meetings have been in Columbia halls; and its office and library have been housed in Columbia buildings. Professor Rudolph E. Langer, of the University of Wisconsin, vice-president of the society, delivered a brief address of appreciation on behalf of the society for what it had received from Columbia (in the words of Professor Langer) "the worthiest and sublimest of gifts . . . a portion of herself." Following this, Professor Langer presented to President Butler a copy of the address, beautifully printed on French hand-made paper, and a copy of each of the two volumes of the Semicentennial Publications, specially bound in brown pigskin and bearing a suitable dedicatory inscription. President Butler responded in a noteworthy address.

The most outstanding feature of the celebration, however, was surely the "Birthday Dinner," at which the society delighted to honor its founder, Professor Thomas Scott Fiske, of Columbia University. It must indeed be almost unique in the annals of scientific organizations for a society to be able to honor its founder in person at its jubilee. To him was presented an illuminated testimonial containing a greeting of appreciation and affection, prepared by order of the society and signed by the president and secretary. There was presented to Miss Natalie P. Fiske, daughter of Professor Fiske, and to the society bronze replicas of a sculptured bas-relief portrait of Professor Fiske, done by the young Philadelphia sculptor, Mr. George John Sklaar, of the faculty of the New Jersey College for Women. A group of mathematicians who had been associated with Professor Fiske in the work of the College Entrance Examination Board presented to the society a portrait of Professor Fiske painted by Mrs. H. E. Ogden Campbell. Professor Fiske spoke in reminiscent vein of interesting events in the early days of the organization.

As a fitting climax to this central event of the celebration, letters addressed to Professor R. G. D. Richardson, secretary of the society, were read from President Franklin D. Roosevelt and Prime Minister W. L. Mackenzie King, of the Dominion of Canada, for the American Mathematical Society extends north of the border. The emphasis reflected in these letters may well be gratifying to all scientists. They are as follows:

From President Franklin D. Roosevelt:

Please extend my greetings to the American Mathematical Society on the occasion of the celebration of its fiftieth anniversary. I trust that genuine satisfaction will come to its members as they contemplate the contribution which the Society has made during the half century of its existence.

It is sometimes difficult to comprehend the values accruing to society from mathematics. It is deeply rooted in social progress as a large part of the technological advance made in recent centuries would have been impossible had it not been for the constant refinement of the essential tool of technology—mathematics. Social sciences also owe a large debt to mathematics. Future advances in the social sciences will be largely dependent upon mathematical treatment of their data.

I congratulate the members of the American Mathematical Society on the important contributions which mathematics has already made. I trust that the years ahead will find mathematicians making significant contributions, as in the past.

From Prime Minister W. L. Mackenzie King:

I shall be pleased if you will extend to the American Mathematical Society, on the celebration of the fiftieth anniversary of its inception, my greetings and warm congratulations upon attaining this significant anniversary.

It is well that we should reflect, on occasions such as this, on the extent to which the learned societies of this continent have contributed to the strength and substance of our national and international life. The work of the American Mathematical Society fills a distinguished place among those academic fellowships which have done so much to keep alive, in our institutions of learning, that integrity of thought which is one of the proudest of our common traditions.

It is my hope that the deliberations of the Society's Jubilee Meeting will be attended by much good fellowship and a lively appreciation of the binding character of the academic fraternity which has so long and so happily prevailed between our two countries.

ALBERT E. MEDER, JR.
NEW JERSEY COLLEGE FOR WOMEN,
NEW BRUNSWICK, N. J.

SPECIAL ARTICLES

REPULSIVE FORCES BETWEEN CHARGED SURFACES IN WATER, AND THE CAUSE OF THE JONES-RAY EFFECT

CONSIDER a plane surface of potential V which bounds a semi-infinite volume of a dilute salt solution of potential 0. Taking the salt to be of the univalent type, such as KCl and applying the Poisson and Boltzmann equations, the potential distribution must satisfy the equation

$$\frac{d^2V}{dx^2} = 4\pi n_0(\epsilon/D)\left[\exp(Ve/kT) - \exp(-Ve/kT)\right], \qquad (1)$$

where n_0 is the number of ions (of each sign) per unit volume in the solution in regions where $V = 0$.

Let us put

$$\eta = Ve/kT \qquad (2)$$

and

$$\theta = x/\lambda \qquad (3)$$

where λ, the value of $1/\kappa$ in the Debye-Hückel theory, is given by

$$\lambda^2 = DkT/8\pi e^2 n_0 \qquad (4)$$

Eq. (1) then becomes

$$2d^2\eta/d\theta^2 = \varepsilon^{\eta} - \epsilon^{-\eta} \qquad (5)$$

In the Debye-Hückel theory it is assumed that η is so small that ε^{η} can be replaced by $1+\eta$. We wish, however, to apply Eq. (5) to two parallel plates which are separated by the distance b but are so close together and are so highly positively charged that $\eta >> 1$, everywhere between the plates. The Debye-Hückel approximation therefore can not be used, but instead, we can neglect $\epsilon^{-\eta}$ in Eq. (5), since it is small compared to ε^{η}.

Integration gives

$$\theta = 2\exp(-\eta_M/2)\tan^{-1}[\exp(\eta - \eta_M) - 1]^{1/2} \qquad (6)$$

where η_M is the minimum value of η which occurs at the plane half way between the plates and θ measures the distance from this median plane. If η_1 and θ_1 are the values of η and θ at the surface of the plates and we take the case that the plates are so highly charged that $\eta_1 >> \eta_M$ then Eq. (6) becomes

$$\theta_1 = \pi \exp(-\eta_M/2) - 2\exp(-\eta_1/2) \qquad (7)$$

where the term containing η_1 is very small compared to that which contains η_M.

Repulsive Forces Between Plates: The plates are acted upon by forces of two kinds: A pressure nkT due to the negative ions and a negative pressure or pull due to electric field E; the sum of the two must be constant for all values of θ in the space between the plates. At the median plane we see from the symmetry that $E = 0$ and therefore the force acting per unit area on the plates is the pressure $p = n_M kT$ where n_M is the concentration of negative ions at the median plane.

The value of n_M can be calculated from η_M by the Boltzmann equation. To obtain the net pressure between the plates we should subtract the pressure $2n_0kT$ which acts on the other side of each plate, giving

$$p = n_0kT(\exp \eta_M - 2) \qquad (8)$$

Since, however, we are taking at present only the case where $\eta_1 >> \eta_M >> 1$ we can neglect the 2 in the parenthesis in Eq. (8) and the last term of Eq. (7) and so from Eqs. (7), (8) and (3), placing $x_1 = b/2$, we obtain

$$p = n_0kT(2\pi\lambda/b)^2 \qquad (9)$$

We can now eliminate λ by Eq. (4):

$$p = (\pi/2)D(kT/eb)^2 \qquad (10)$$

This gives the repulsive force between two planes with high charges of similar sign when they are separated by a distance which is small compared to 2λ. It is interesting to note that this limiting expression does not contain the potential of the plates, the concentration of the electrolyte or any other adjustable parameter. The force varies inversely as the square of the distance between the plates. To determine its numerical magnitude let us place $D = 81$ (the dielectric constant of water at 20° C), $T = 293°$ K and so obtain

$$p = 8.90 \times 10^{-7}/b^2 \text{ dynes/cm}^2 \qquad (11)$$

Thus, when the surfaces are at a distance of 10^{-4} cm (1μ) the repulsive force is 89 dynes cm^{-2}.

This repulsive force, which involves no new mechanism, together with attractive Coulomb forces, is found to be of just the right magnitude to account for the formation of tactoids and unipolar coacervates (which involve the spontaneous separation of certain colloidal solutions into two liquid phases).[1]

Repulsion Between a Plate and an Air-Water Interface: The same pressure p, which acts according to Eq. (10) between two plates separated by the distance b, should also act between a single plate and an air-water interface at a distance $b/2$, for in both cases at a distance $b/2$ from the plate the boundary condition $d\eta/d\theta = 0$ is fulfilled. If then a highly charged (ζ-potential) plate held vertically is partly raised out of a dilute water solution of an electrolyte, the water should drain off until a limiting thickness t is reached, where t will vary with the height h above the water surface. In the liquid of the film when equilibrium has been reached there will be a pressure

$$p = -\rho gh \qquad (12)$$

if the pressure at the free horizontal surface is zero. Here ρ is the density and g the acceleration of gravity.

The surface of the water film is acted on by this negative pressure and by the positive outward pressure p given by Eq. (10), and these two forces must be equal. Eliminating p between Eqs. (10) and (12), we find that the film thickness is

$$t = (kT/e)(\pi D/8\rho gh)^{1/2} = 1.52 \times 10^{-5}/h^{1/2} \text{ cm} \qquad (13)$$

if we take $D = 81$, $T = 293°$ K, $\rho = 1$, $g = 980$. Thus at a height of 10 cm above the horizontal water surface the film of water should have a thickness of 480 Å.

Experiments are under way to measure the thickness of such films on barium stearate multilayers of critical thickness, which have been made hydrophilic by conditioning in thorium nitrate and sodium silicate. Because of the negative pressure in the water in these films, the vapor pressure of the water must be lowered, but calculation shows that an elevation of temperature of only 0.001° C would decrease t from 480 Å to 165 Å. To obtain data for a quantitative test of Eq. (13) it will be necessary to have good temperature control.

Water Films on the Walls of Capillaries: In a capillary tube of radius r in presence of saturated water vapor, there will also be a water film.

Because of the curvature (one half that of a sphere of equal radius) the surface tension γ exerts a force or pressure γ/r on the surface of the film that acts in the same direction as that given by Eq. (10). Thus in place of Eq. (13) we have

$$\Delta r = (kT/e)[\pi D/8(\rho gh - \gamma/r)]^{1/2} \qquad (14)$$

Surface Tensions of Dilute Salt Solutions: Jones and Ray,[2] by developing an extremely accurate differential method for measuring relative surface tensions, have found an extraordinary effect by which very low concentrations of salts appear to *decrease* the surface tension of water. The effect occurs only at molar concentrations (of KCl) below about 8×10^{-4} and the maximum decrease amounts to about 0.015 dyne cm^{-1}.

The theory outlined above which led to Eq. (14) seems to offer a simple explanation of the Jones-Ray effect. A water film on the wall of the capillary has the effect of decreasing the effective radius so that the solution rises to a greater height than if such a film were not present. The film disappears at higher salt concentrations because the charge (ζ-potential) becomes less (or λ becomes comparable to Δr), and thus the capillary rise h_s decreases and produces an apparent decrease in surface tension.

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[1] A paper soon to appear in the *Journal of Chemical Physics.*

[2] Grinnell Jones and W. A. Ray, *Jour. Am. Chem. Soc.*, 59: 187, 1937.

If we measure the capillary rise in a tube of radius r whose walls are covered by a water film of thickness Δr the surface tension of the water should be calculated by

$$\gamma = \tfrac{1}{2}\rho g h(r - \Delta r). \qquad (15)$$

Jones and Ray, however, calculated their surface tension by the equation

$$\gamma_{JR} = \tfrac{1}{2}\rho g h r. \qquad (16)$$

The value of Δr can be calculated by Eq. (14) by inserting $\gamma/r = \rho g h/2$, so that we have

$$\Delta r = (kT/2e)(\pi D/\rho g h)^{1/2} = 2.16 \times 10^{-5}/h^{1/2} \qquad (17)$$

According to this interpretation the values of γ_{JR} at low concentrations are higher than the true surface tension of water by an amount:

$$\gamma_{JR} - \gamma = (kT/4e)(\pi D \rho g h)^{1/2} = 0.0107 h^{1/2} \qquad (18)$$

Jones and Ray in all their experiments used a single capillary of radius $r = 0.01361$ cm, and the capillary rise was $h = 10.8$ cm. According to Eq. (18) the increment $\gamma_{JR} - \gamma$ should have been 0.035 dyne cm^{-1}. This is of the same order of magnitude as the apparent decrease in surface tension of 0.015 dyne cm^{-1} which they observed at concentrations below 10^{-3} M.

The values of Δr and $\Delta\gamma$ given by Eqs. (17) and (18) have been based on the assumptions that $\Delta r << \lambda$ and $\eta_1 >> \eta_M >> 1$. When these conditions are not fulfilled, Δr and $\Delta\gamma$ will have lower values.

In the following table the values of λ are given for various assumed concentrations between 10^{-3} and 10^{-5} M as calculated from Eq. (4). The next column contains values of $\Delta\gamma$ from a curve plotted from data of Jones and Ray for KCl. From these we can calculate values of Δr which would account for these values of $\Delta\gamma$. The last column gives η_M as calculated from Eq. (8) by inserting $p = \rho g h/2 = 5300$ dynes cm^{-2}. The values of λ decrease far below the maximum value of Δr (280 Å), but Δr decreases too, so that in all cases the condition $\Delta r << \lambda$ is approximately fulfilled. The reason that Δr never rises as high as 650 Å, which is given by Eq. (17), is that the condition $\eta_1 >> \eta_M$ is not fulfilled at the lowest concentrations.

TABLE I

CALCULATIONS BASED ON THE SURFACE TENSION DATA OF JONES AND RAY FOR KCl

Molar concentration	λ	$\gamma_{JR} - \gamma$ dyne cm^{-1}	Δr obs	η_M
0.0010	97 Å	0.000	..	0.46
.0005	137	.0014	26 Å	0.65
.0003	178	.0065	122	0.82
.0002	217	.009	174	1.01
.0001	307	.012	230	1.36
10^{-5}	970	.015	280	3.15

The ζ-potentials determined by the electric mobility of particles of glass and quartz[8] are negative and are of the order of 50 to 100 millivolts at concentrations of about 10^{-5} to 10^{-6} M and decrease rapidly as the concentration rises from 10^{-4} to 10^{-3} M. The highest values of η_1 calculated by Eq. (2) from these potentials thus range from 2 to 4. The marked decrease in η_M to low values shown in Table I as the concentration increases is probably the cause of the decreases in Δr and $\Delta\gamma$ at higher concentrations.

These rough calculations show that the Jones-Ray effect can be adequately explained on the basis of a water film held on the surface of the capillary tube by electric charges bound by the quartz.

The present paper is merely preliminary. It has been possible to obtain a complete integration of Eq. (5) in terms of elliptic functions. Some calculations have shown that by applying these exact expressions to the experimental data of Jones and Ray it is possible to calculate the potential of the quartz surface at each concentration. These potentials are reasonable and vary with the concentration in the manner shown by mobility experiments.

Further experiments should make it possible to check this suggested theory. For example, we see by Eq. (18) that $\Delta\gamma$, which does not represent a true change in surface tension, should vary in proportion to $h^{1/2}$ or $r^{-1/2}$. The addition of thorium nitrate in concentration of 10^{-6} M brings the ζ-potential of glass to about zero.[8] This should eliminate the Jones-Ray effect. If solutions of proteins are passed through the capillary and this is then carefully washed, the ζ-potential can be made to vary through wide ranges, depending on the choice of protein, and the pH of the solution. This should cause marked variations in the Jones-Ray effect.

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THE EFFECTS OF AGE AND ESTROGEN ON THE STROMA OF VAGINA, CERVIX AND UTERUS IN THE MOUSE[1]

UNDER normal conditions an increase in the amount of collagen in the stroma of vagina, cervix and uterus of mice begins in the first few weeks of life and from then on progresses more definitely in older mice, especially after cessation of the sexually active period. However, on the whole the differences found at different age periods are relatively not great as compared with those experimentally produced through the administration of estrogen. Injections of estrogen extending over long periods increases the amount of fibrous-hyaline material which is deposited in the stroma; this increase is the greater, the larger the amounts of estrogen injected at each period and the longer it is continued. If very large doses of estrogen (100 or more rat units in oil) are injected weekly, large amounts of a hyaline substance are deposited, which act as foreign bodies and cause the formation of epithelioid and giant cells and an ingrowth of connective tissue. Thus an organization of this substance is attempted, which is interrupted, however, by renewed deposition of this hyaline material. In certain places solution processes seem to be associated with the hyalinization of the connective tissue and non-striated muscle layers. No definite statement can be made at present as to the chemical nature of this substance and its possible relation to a plasma constituent, except that it is not amyloid.

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[8] H. A. Abramson, "Electrokinetic Phenomena," Chemical Catalog Company, New York, 1934. See pp. 203–8.

[1] These investigations were carried out with the aid of grants from the International Cancer Research Foundation and from the Committee on Research in Endocrinology of the National Research Council.

A hormone, estrogen, may affect therefore the stroma of various organs in two opposite directions: By inducing growth processes in the epithelial structures and perhaps also by definite changes in the circulation it may cause an activation of the stroma and a diminution in the amount of fibrous-hyaline material in various tissues; this seems to occur also in uterus and vagina under certain conditions. But if very large doses of this hormone are administered over long periods of time, the opposite effect may be obtained, namely, a very intense fibrosis and hyalinization of the stroma which may induce abnormal reactions in the surrounding tissue. In this way it seems to be possible to accelerate and intensify very much some of the old age changes in certain organs.

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THE EFFECTS OF AGE AND HORMONES ON THE STROMA OF THYROID AND MAMMARY GLAND IN THE GUINEA PIG[1]

IT is assumed that one of the changes characteristic of old age in higher organisms consists in an increase and condensation of the collagen in the stroma of various organs and that such changes may reduce the metabolic activities of sensitive tissues. We have begun, therefore, a study of the changes which take place in the stroma at different age periods, as well as of the effect of various hormones on this tissue.

(1) In the thyroid gland of guinea pigs at about the time of birth the amount and density of the stroma are relatively slight. From then on a constant increase in the amount of fibrous tissue takes place, especially around the arteries, but less about the veins and least around the lymph vessels. This increase is already considerable in young, sexually immature female guinea pigs weighing about 180 grams; it increases still more in older guinea pigs, although in individual cases certain variations occur in this respect. Growth and functional stimulation of the thyroid gland by the stimulating hormone of the anterior pituitary gland causes a partial loosening of the stroma, owing to increased transudation from the blood vessels. However this does not, as a rule, cause a noticeable loosening of the dense fibrous tissue directly surrounding the arteries.

(2) In the mammary gland and in the surrounding fat tissue changes occur similar to those observed in the thyroid gland of young and adult guinea pigs; but here much dense fibrous tissue develops, not only around the blood vessels, but also around the larger ducts. There is less fibrous tissue around the end ducts and acini, which function and grow actively; however, a complete parallelism between the amount and density of the stroma in thyroid and mammary gland does not exist because of the differences in functional and growth changes and other more accidental factors in these organs.

In the mammary gland a transformation of the dense fibrous-hyaline into loose fibroblastic, fibrillar stroma can be readily accomplished under the influence of hormones which stimulate the growth of the mammary gland tissue. Implantations of pieces of cattle anterior pituitary gland previously treated with formalin or with urea and glycerin are very efficient for this purpose; they cause maturation of ovarian follicles and the discharge of oestrogen into the circulation. Accompanying the growth processes in the epithelium of the mammary gland a marked stimulation of the surrounding stroma occurs, leading to mitotic proliferation and amoeboid movement of fibroblasts. They readily change the dense fibrous tissue around the ducts into a loose and much more permeable fibrillar, cellular stroma. These effects begin around the glandular structures, but they may extend from there with gradually diminishing intensity also to the adjoining fibrous-hyaline material around arteries and to the fibrous-hyaline bands in the fat tissue. This condition suggests the action of hormone-like contact substances which are given off by the active gland structures and which then diffuse for a certain distance into the neighboring stroma. Such a conception would agree with our earlier conclusion that contact substances might be responsible for growth and move-

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[1] These investigations were carried out with the aid of grants from the International Cancer Research Foundation and from the Committee on Research in Endocrinology of the National Research Council.

ments of previously resting cells surrounding active cells or tissues. While in the mammary gland hormones in all probability affect the stroma only indirectly by way of the glandular structures, a hormone given off by the corpus luteum is able to exert a direct growth-stimulating effect on the uterine stroma.

We may then conclude that an increase in amount and density of stroma elements in certain organs begins very early in life and progresses steadily from then on, and that hormones may counteract this effect by loosening the stroma in three different ways, namely: (1) by their effect on the circulation; (2) by their stimulating action on epithelial parenchyma and (3) by a direct effect on the stroma. These observations suggest that the fibrosis and hyalinization of the stroma which occurs with advancing age may perhaps be reversible under the influence of hormones, at least in certain instances.

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AN ADRENALINE-LIKE SUBSTANCE IN POSTGANGLIONIC SYMPATHETIC FIBERS

By using bicarbonate-free Ringer's solution containing physostigmine (1:50,000) extracts were made from different nerves of the cat, dog, rabbit and frog. The extracts were dialyzed against physostigmine-Ringer's solution by the method of Loewi.[1] After four hours the dialysate was tested on isolated hearts of frogs, according to the method of Straub. Control experiments were made with the other acetylcholine extraction methods (acid alcohol, trichloracetic acid and heating) and were tested on the frog heart, rectus abdominis of the frog and the back muscle of the leech.

Extracts of various nerves (vagus and sympathetic of the neck, sciatic, phrenic, optic, thoracic sympathetic chain and superior cervical ganglion) contain different amounts of acetylcholine.

Preganglionically denervated superior cervical ganglia (with the postganglionic fibers) of the cat and rabbit, one to two weeks after operation, no longer contain acetylcholine, but an adrenaline-like substance having positive inotropic and chronotropic effects on the frog heart. In cats and dogs the ventral esophageal branches of the vagi were cut below the diaphragm. After two weeks the postganglionic sympathetic fibers along the superior mesenteric artery were extracted and were found to contain no acetylcholine but an adrenaline-like substance.

If extracts of mixed nerves were made with bicarbonate-free Ringer's solution without physostigmine, acetylcholine was totally eliminated and only the adrenaline-like substance was present.

These experiments showed that from all the nerves examined which contain postganglionic sympathetic fibers an adrenaline-like substance can be extracted. The vagus fibers of the dog, but not of the cat, contain this substance. Evidence of its presence was found in extracts from the cervical sympathetic ganglia and their fibers, from the sciatic, from the superior mesenteric plexus and ganglion, but not from the phrenic nerve.

This adrenaline-like substance passes easily through a dialysis membrane (Cellophane), is oxidizable and is destroyed by ashing or simple heating to near the boiling point for a few minutes. It has positive inotropic and chronotropic effects on a hypodynamic frog heart, which are abolished by ergotoxine. The substance has a positive action on the blood pressure of the cat (adrenals ligated). The substance has properties similar to sympathin and adrenaline. On the assumption that it is sympathin the highest content was found in the superior mesenteric plexus of the cat (about 4 to 6 γ per gram of nerve). The amount from the superior mesenteric plexus of one cat is enough to cause, when intravenously injected, a rise of 20 mm Hg. in the blood pressure of another cat. This action on the cat's blood pressure provides the possibility of studying the properties of sympathin more completely in further experiments.

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[1] O. Loewi, *Pflüger's Arch.*, 227: 504, 1936.

BOOKS RECEIVED

Catalogue des Manuscrits Ethiopiens de la Collection Griaule, Première Partie, Sections I–VI; Travaus et Memoires de L'Institut D'Ethnologie, XXIX. Pp. ix + 320. 8 plates. Institut D'Ethnologie, University of Paris. 125 fr.

The Collected Works of George Abram Miller; Vol. II. Pp. xi + 537. University of Illinois. $7.50.

Hoffmann, Ralph. *Birds of the Pacific States.* Pp. xix + 353. Illustrated. Houghton Mifflin. $3.50.

Roberts, W. R. Westropp. *Elliptic and Hyperelliptic Integrals and Allied Theory.* Pp. viii + 311. Cambridge University Press, Macmillan. $3.75.

Rojansky, Vladimir. *Introductory Quantum Mechanics.* Pp. x + 544. Prentice-Hall. $5.50.

The Snellius-Expedition in the Eastern Part of the Netherlands East-Indies, 1929–1930, under the Leadership of P. M. Van Riel; Vol. I, Voyage. Pp. viii + 177. Illustrated. 20 guilders. *Vol. II, Part 4, Oceanographic Results; Surface-Observations, Temperature, Salinity, Density; by Dr. S. W. Visser.* Pp. 62. 5 guilders. E. J. Brill, Leiden, Holland.

Strong, John and others. *Procedures in Experimental Physics.* Pp. x + 642. Illustrated. Prentice-Hall. $5.00.

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ABSTRACTS OF PAPERS PRESENTED AT THE CHAPEL HILL MEETING OF THE NATIONAL ACADEMY OF SCIENCES

Vacuolation a factor in the division of animal cells: **H. V. Wilson.** Division of the animal cell is usually described as brought about through the activity of an outer denser layer, the ectoplasmic layer, which by a process of constriction or in some other way cuts the mass in two. This idea irresistibly comes into the mind as we observe the segmentation of living eggs. Only a part, however, can be learned from such observation. The interior must be seen and sections become necessary. Sections through early stages in the segmentation of fish eggs (shad, sea bass) and of the small holoblastic egg of a gephyrean worm (Thalassema) all show the following points. (1) The cells are not complete in the sense that each shall have an ectoplasmic layer of its own. Adjoining cells are separated only by single partition walls, the partition being common to the two cells. (2) A cell may enter upon division before it is completely separated by a partition from its sister cell. (3) A partition wall is foreshadowed by an arrangement of vacuoles which in sections appears as a row. (4) The partition itself appears piecemeal and is very often observable in the interior of the mass when it has not yet formed at the surface. (5) The pieces of the developing partition bear such relations to the vacuoles as to force the conclusion that they are formed as lateral thickenings of the vacuolar walls, the thickened areas uniting and the vacuoles eventually disappearing.

Can mitochondria be used to identify mammalian germ cells?: **Geo. T. Hargitt** (introduced by H. V. Wilson). There are two main views regarding the functional germ cells of mammals: (1) These are all direct descendants of primordial germ cells arising in the early embryo; (2) while embryonic germ cells are present, they usually degenerate and the functional germ cells arise secondarily from the germinal epithelium of the gonad, either in the immature or adult animal or in both. It has frequently been stated that evidence of the first view is furnished by the form of the mitochondria, germ cells possessing granular mitochondria and all other cells filamentous or rod-shaped mitochondria. Post-natal stages of male and female rats have been studied to test the latter claim.

In the female, the germinal epithelium, follicle cells, fibroblast cells and the epithelium of Fallopian tube and uterus characteristically have filamentous mitochondria. Oocytes near the germinal epithelium and in the cortex of the ovary have rod-shaped mitochondria; the ova in primary follicles either short rods or granules or both; ova in Graafian follicles finely granular mitochondria; corpora lutea and atretica mostly granules and some short rods. As the ovum grows, the few rod mitochondria are gradually replaced by fine granules which become more numerous. The number and form of mitochondria would seem to be indicative rather of activity than of cell specificity, especially as the original filamentous mitochondria of the follicle cells become transformed into granules as the corpus luteum develops and becomes active. The germ cells of the male follow a different course. Up to 21 days post-partum the large cells of the seminiferous cords, usually designated as primordial germ cells, typically contain large granular mitochondria, and such cells divide mitotically during this period. Other cells of the cords have filamentous mitochondria. After 21 days the usual cell generations of the spermatogenetic cycle begin to develop. From this time granular mitochondria are rarely seen, but all the cells of the seminiferous tubules, whether germ cells or Sertoli cells, are possessed of rod-shaped mitochondria, either straight, or in rings and loops. Reports on various adult mammals show that the mitochondrial content may change in amount and form during the spermatogenetic cycle; and observations on several mammals indicates that they do not all agree in the mitochondrial form at different phases of germ-cell history. It would seem, therefore, that the form of the mitochondria can not safely be used to distinguish germ cells from other cells.

Studies on fragments of centrifuged Nereis eggs: Donald P. Costello (introduced by H. V. Wilson). When the unfertilized eggs of Nereis limbata are centrifuged at 66,000 times gravity for 60 to 80 minutes, the interior protoplasm becomes stratified and the eggs are elongated into a dumb-bell form. Due to their shape, the eggs usually orient in the centrifuge with the polar axis perpendicular to the axis of centrifuging. Egg fragments were obtained by cutting the dumb-bells, after removal from the centrifuge, by hand with micro-needles. Three types of cuts were made: "upper," across the neck of the dumb-bell; "lower," across the lower edge of the yolk zone; and "intermediate," through the yolk zone. The centripetal fragment contains the germinal vesicle, and its cytoplasmic constituents differ from those of the centrifugal fragment. Upon insemination, either fragment or both may be activated. While activated centripetal fragments usually cleave, the centrifugal fragments never do so. The centripetal fragments produced by the "upper" cut rarely develop into larvae bearing prototrochal cilia, although they may attain a sufficiently advanced multicellular condition. Ciliated larvae develop frequently from the "lower" centripetal fragments, less frequently from the "intermediate" centripetal fragments. These experiments indicate that some substance in the centripetal hemisphere, probably derived from the germinal vesicle, is essential for development; and that materials near or below the neck of the dumb-bell of the centrifuged Nereis egg are essential for the development of a larva bearing prototrochal cilia.

Experiments on the relation of nutrition to the composition of the body and the length of life: H. C. Sherman, H. L. Campbell and C. S. Lanford. The influence of food becomes more apparent when the experiments are continued beyond a single generation. In second (or later) generations the calcium content of the body is found to differ widely throughout the period of most rapid growth and measurably also in the fully developed adult, according as the calcium content of the family food supply is only slightly above the level of minimal adequacy or is considerably higher. Adult vitality and length of life also average higher in the families whose food supplies contain liberal rather than low margins of surplus of calcium above the merely adequate level. Experiments with reference to the relation of the level of intake of vitamin A (proportion of butterfat in the diet) upon growth, length of life and vitality of offspring will also be discussed briefly.

Nicotinic acid in the treatment of canine blacktongue and human pellagra: David T. Smith and Susan Gower Smith (introduced by Wm. deB. MacNider). In September, 1937, Elvehjem, Madden, Strong and Woolley, of the University of Wisconsin, published their preliminary report that nicotinic acid cures canine blacktongue. By December, 1937, their results had been confirmed by Street and Cowgill, of Yale, and Dann, of Duke. This was followed by a more extensive study by Smith, Margolis and Margolis (1938) of Duke and Sebrell, Onstott, Fraser and Daft (1938) of the U. S. Public Health Service. Smith, Margolis and Margolis showed that the vitamin potency of nicotinic acid is not injured by autoclaving at 15 pounds pressure for six hours. Recent work by the same investigators at Duke has shown that a dose of 0.1 mg per kilogram, given daily for 10 days, fails to cure blacktongue, 0.2 mg per kilogram is slowly effective, but 0.5 mg per kilogram gives rapid and dramatic cures. Doses of 10.0 mg per kilogram were no more effective than 0.5 mg. The Goldberger blacktongue-producing diet is primarily deficient in the pellagra-preventing factor, but is partially deficient in thiamin chloride (B_1) and riboflavin. Sebrell, Hunt and Onstott; Zimmerman, Cowgill and Fox (1937) observed the riboflavin deficiency and Margolis, Margolis and Smith[1] at Duke the B_1 deficiency. Nicotinic acid cures the primary deficiency and gives as good results as liver or yeast with the first two consecutive attacks of blacktongue. After the third attack the oral lesions are cured, but the animals do not gain weight. If the secondary deficiencies are corrected by giving B_1 and riboflavin along with the nicotinic acid dogs can be maintained in good condition for as long as 12 months. Pyridine B—carboxylic acid diethylamide (Coramine) cures blacktongue at levels of 5 to 10 mg per kilogram. Although larger doses are required it has the advantage of being less toxic and will protect the dogs from a new attack for much longer than the maximum doses of nicotinic acid. Patients with pellagra have been cured with nicotinic acid by Fouts, Helmer, Lepkovsky and Jukes (1937); Smith, Ruffin and Smith (1937); Harris and Hassan (1937); Spies, Cooper and Blankenhorn (1938); and France, Bates, Barker and Matthews (1938). The dose used by Smith, Ruffin and Smith was 1.5 mg per kilogram each day. This was three times the minimal effective dose in the dogs. Ruffin and Smith have obtained dramatic cures in 10 cases of acute pellagra with this dose of nicotinic acid. Toxic symptoms appeared in one patient and in 5 normal medical students after taking 1 gram of nicotinic acid daily for 5 days. There is, however, a large margin of safety between the effective dose and the toxic dose. All the evidence indicates that the pellagra preventive factor of Goldberger is nicotinic acid.

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[1] Detailed accounts of the blacktongue experiments by Margolis, Margolis and Smith are in press (*Jour. Nutrition*) at the present time.

The polarity potential of the human eye: WALTER R. MILES. The human eye, in common with other tissues of the body, shows fairly constant electrical potentials. The anterior portion is positive and the posterior or retinal area is negative. The potentials can be led off from the tissues just next the eye somewhat as the heart currents are led off by connecting a patient's wrists and the left ankle to a measuring instrument. Very small metal foil discs are attached to the skin with adhesive on either side, above and below each eye. These electrodes are connected through a vacuum tube microvoltmeter to a delicate galvanometer, the deflections of which are photographed. The eye now acts as both battery and switch, since turning the eye changes the contact relationships of its front and back with the electrodes. The farther the eye is turned in the orbit the stronger the potential indicated on the galvanometer, and as long as the eye remains fixed at one point, the potential holds steady at a value dependent on the eye's position. When their eyes are turned 30° from the primary line of regard, which angular distance may be used as a standard test, children and adults show potentials ranging from .0002 to .002 volt from each eye. The amount of light falling on the eye at the time of measurement makes only a small difference in the result. One eye may differ markedly from its mate, just as people differ among themselves. Repeated measurements on the same person as a rule agree well. Apparently the eye potential is not easily disturbed by the minor defects which interfere with visual efficiency. That it is inherent in the tissues or tissue relationships of the eyeball, rather than derived from the eye muscles and tissues lining the orbit, is indicated by the fact that the potential is absent when the eyeball has been removed. Patients with one glass eye do not give a potential on that side, even though much of the muscle tissue remains. The fundamental cause of the polarity potential in the eye remains to be discovered. Preliminary data on the possible influence of various factors are presented.

The Oligocene-Eocene boundary in the Rocky Mountain and Pacific Coast regions: WILLIAM BERRYMAN SCOTT. The Far West of the United States, including the Rocky Mountains and Pacific Coast provinces, contains the most wonderful museum of ancient mammalian life known in the world; and no more convincing proof of the theory of evolution can be found than is given by the successive developments of various lines of mammalian descent, such as horses, camels, rhinoceroses, etc. In order to make this evidence available to naturalists, it is essential that the chronological order of the deposits which contain the fossils shall be established beyond doubt; and the paper deals with a small part of the Tertiary period, namely, the Upper Eocene and Lower Oligocene, and the problem of fixing the boundary between these two divisions of geological time; more especially in the great series of fresh-water river and lake deposits which are found in the high plateau of southern Wyoming, northern Utah and the adjoining parts of Colorado, where aridity tends to prevent the growth of the cover of vegetation. The formations in question are all of continental origin, partly lake deposits, partly river deposits. In southern Wyoming the areas usually assigned to the Middle Eocene or Bridger stage are in two separate basins; one around Fort Bridger, extending for many miles in every direction from that center; the other east of the Green River, which extends down to the foothills of the Uinta Mountains and around the east end of those mountains into Colorado and Utah. The subdivision of these beds has given rise to considerable controversy because of the gradual change from one stratigraphical subdivision to another. There is no question as to the order of succession, but as to the boundaries where the lines should be drawn. The Upper Eocene or Uinta formation is clearly subdivided into three substages, which are called respectively A, B and C. Above these comes the thick Duchesne River, and this is generally regarded as the summit of the Eocene, but I am more inclined to consider it the basal member of the Oligocene. In southern California there is a very thick bed of continental origin known as the Sespé. This is some 7,000 feet thick and rests unconformably upon marine Eocene and is overlain unconformably by marine Miocene. It seems thus to represent the whole of the Oligocene. In the lower part of the Sespé is found a fauna very similar to that of the Duchesne River, and the upper part resembles that of the John Day in eastern Oregon.

Origins of cave faunas: A. S. PEARSE (introduced by Ross G. Harrison). Yucatan is a great sheet of limestone which has been uplifted from the ocean in rather recent times. Its caves and cenotes contain a number of interesting troglobites which throw some light on the origins of cave faunas. Caves have been populated by invasions from ocean, epigean and subterranean bodies of fresh water, and land. Animals have occupied caves in order to secure shelter and to take advantage of the stability of environmental conditions, especially temperature and humidity. Of some three hundred species collected in the caves of Yucatan, most are such as may be found elsewhere. Less than a tenth are troglobites. Though caves are continually occupied for longer or shorter periods by animals from other habitats, few become adapted to life in caves to such a degree that they show characteristic lack of pigment, degenerate eyes, attenuation of tactile organs, lack of seasonal periodicity in reproductive activities, etc. Cave bats fly continually into the epigean world and bring back materials which directly or indirectly constitute important food resources for small animals. In Yucatan certain troglobite diplopods belonging to the Genus Yucodesmus show specific segregation which has apparently been brought about by isolation. Cave crickets and crustaceans, on the contrary, are widely distributed; the former perhaps because they spread above ground during humid, dark periods and the latter because they emigrate through ground waters.

Structure and automorphisms of semi-simple Lie groups in the large: N. JACOBSON (introduced by S. Lefschetz). The present paper attempts to fill in several gaps that appear in the literature relating Lie algebras to continuous groups. It is shown that semi-simple Lie algebras over the field of real numbers are in (1–1) correspondence with semi-simple Lie groups in the large (equivalence defined by local isomorphism), simple Lie algebras with simple Lie groups. We also give a new set of linear groups which serve as representatives of the classes of locally isomorphic simple Lie groups. Omitting a finite number of exceptions these are simply the important geometric linear groups with real, complex or quaternionic elements (*e.g.*, unimodular, orthogonal groups). We determine the group A of continuous automorphisms of the "unexceptional" groups and discuss the structure of A/A_0 where A_0 is the component of the identity of A.

Spiraling compound curves: T. F. HICKERSON (introduced by H. V. Wilson). This paper presents a study of compound curves of various types with a view of inserting transition spirals providing a gradual change of curvature from one branch to the other of the compound curve. At the junction of two curves of different radii, called the point of compound curvature, there is an abrupt change of curvature similar to that existing at the point of tangency of a straight line with a circular arc. For the latter condition, the use of a transition spiral to effect a gradually increasing change of curvature from the straight line to the circle is a well known and well-established procedure in both railroad and highway design. The circular curve is here shifted radially inward far enough to make room for the spiral. This radial shift depends upon both the degree of curvature of the circular arc and the desired length of transition spiral. In the analogous case of a compound curve, one of the curves must be considered fixed in position, while the other curve is shifted radially a small distance (p) to facilitate the transition. If the flatter curve remains fixed, the sharper curve is shifted inward; but if the sharper curve remains fixed, the flatter curve is shifted outward. As in the case of the transition from a straight to a circular path, the amount of shift for either curve depends upon the total change of curvature and the length of spiral affording the transition. The length of spiral varies theoretically as the cube of the speed of cars (in miles per hour) and inversely as the radius of the curve. Two right-hand or left-hand circular curves separated by a short tangent are treated as special cases of compound curves. Here the alignment is much improved in appearance and riding qualities by the substitution of uninterrupted continuous curvature with transition spirals in the place of the intervening short tangent.

Plant disease fungi constantly evolving new types: E. C. STAKMAN. Evolution is a very real and active process in many of the most destructive plant disease fungi. There are many different parasitic strains, and new ones are continually being produced by hybridization between existing strains and by sporting or mutation. How a multitude of new types or strains arise in a single species of smut fungus is illustrated well by the corn smut fungus. Several years ago a single reproductive cell of this fungus was isolated and its offspring propagated in the laboratory. Within a few months 162 distinct strains of this one fungus had been produced by mutation among the descendants of the original single cell. During the past several years more than a thousand types have resulted from the progeny of two single germ cells which were mated. In all, there were developed several thousand types among the progeny resulting from the union of these two single cells. The number of strains that can be produced by hybridization and sporting or mutation in this one fungus is almost unlimited. Some of these strains differ from each other in their appearance on nutrient media in the laboratory, some in physiologic characters and some in parasitism; naturally, therefore, there are numerous parasitic strains of such smut fungi and new ones are continually being produced. Extensive investigations also have been made of some of the most destructive rust fungi, particularly that causing the stem rust of wheat and other small grains. Within the single species of fungus that causes the stem rust of wheat there are varieties which in general look alike but differ in behavior. Thus there is one well-known variety of stem rust that can attack wheat and barley but not rye and oats; there is another that can attack rye and barley but not wheat and oats; and still another that can attack oats but none of the other small grains. Under the microscope they all look very much alike, but their parasitic appetites differ. And the subdivision into strains goes still further: more than 150 parasitic strains of the variety of stem rust that attacks wheat can be recognized by their parasitic effect on twelve varieties of wheat. Furthermore, new parasitic strains are continually being produced by hybridization between existing strains on the barberry plant, which is the alternate host for the rust. This natural evolution of new types of plant disease fungi does not occur only in the laboratory but is going on in nature, as is evident from results obtained during the past few years. About ten years ago, for example, a new parasitic strain of the wheat stem rust was found for the first time in the Middle West. Within ten years it has spread to virtually the entire North American continent and has become by far the most prevalent strain. It is particularly important because it is especially severe in its attack on a variety of wheat which had been resistant prior to the advent of the new strain of rust. The fact that so many types of plant disease fungi exist within a single species and that new ones are continually being produced makes it imperative that the evolution of these disease fungi be studied carefully in order that breeders of crop plants may keep a stage ahead of nature as a breeder of new types of plant disease. In the past, new varieties of crop plants often have been produced which were resistant to a given disease for several years, only to have a new strain of the disease organism pop up to attack the same variety later. There is therefore a contest between breeders of resistant varieties and nature as a breeder of new types of plant diseases. The development of disease-resistant varieties in many cases, therefore, must be a continual process.

The distances of 1,350 stars determined at the Leander McCormick Observatory: S. A. Mitchell and D. Reuyl. The year 1938 marks the completion of one hundred years of measurements of stellar distances or parallaxes. By the year 1910 there had been determined the approximate distances of 100 stars. Photographic work was started at the University of Virginia late in the year 1914. A volume soon to be published will give the details of 650 stars, bringing to 1,350 the grand total of McCormick parallaxes. These trigonometric parallaxes directly determined are in close agreement with the parallaxes derived at the Mount Wilson Observatory by indirect methods by the spectroscope. The McCormick program includes relatively faint stars of large proper motions and also all the brightest stars accessible for observation from our latitude. The material covers stars of all spectral types and hence the results permit a comprehensive study of intrinsic stellar brightnesses or absolute magnitudes. Of particular interest for the investigation of problems of stellar stability is the question of the reality of a gap between "giants" and "dwarfs" for K and later types, and also the question of "intermediate" white stars and "white-dwarfs." For the nearest stars, the trigonometric parallaxes have a higher accuracy than the spectroscopic. The recent claim that the spectrum of the faint star Wolf 424 shows it to be our nearest neighbor in space has not been substantiated by McCormick measures. There are at least 30 nearer stars.

Some recent observations of sunspot spectra: Harold D. Babcock. With the 150-foot reflecting telescope of the Hale Solar Laboratory in Pasadena and a new concave grating spectrograph a reconnaissance has been made of two regions of the sunspot spectrum hitherto unexplored. The more fruitful of these is in the infra-red, $\lambda\lambda 9900$–11200, where many striking differences are found between the spectra of spot and solar disk. The other is in the ultra-violet, where atmospheric and instrumental scattering of light imposes much difficulty. The observations have been made on spots of only medium size. With more favorable conditions further additions to our knowledge may be expected. The behavior of several interesting elements as shown in the infra-red is described qualitatively and found to be in agreement with Miss Moore's observations in the visible region.

The interpretation of showers below thick layers: L. W. Nordheim (introduced by Arthur H. Compton). With the assumption of the barytronic nature of the hard component of the cosmic radiation a large part of the electron showers under thick layers of heavy materials and underground can be explained as due to collision secondaries of fast barytrons. This hypothesis leads to the following results which are, at least, in good qualitative agreement with observation: The number of showers of a given size will be nearly independent of the atomic number of the generating material. The fraction of soft intensity in equilibrium with the hard component underground is of the order 20 per cent. (observed about 25 per cent.), the ratio of single secondaries and small showers to hard rays emerging from lead as obtained from cloud chamber observations checks very well with theoretical estimates. It follows, furthermore, that a considerable fraction of the soft intensity at sea level must be due to the same cause. It is, however, likely that contributions from other processes, though quantitatively of lesser importance, are not entirely negligible. The above explanation could not be maintained with protons as primaries, as they can not produce electron secondaries of sufficiently high energy.

Adiabatic nature of β-decay: M. H. Hebb (introduced by E. C. Kemble). It would appear at first glance that the change in nuclear charge in a β-transformation should be non-adiabatic with regard to the atomic electrons, since the time required by the β-particle to reach the outermost shells can be much shorter than the atomic periods. The experiments of Crane and Halpern for detecting the neutrino require an adiabatic β-process, *i.e.*, that the atomic electrons pass adiabatically from the ground state appropriate to the initial nuclear charge to that for the final nuclear charge during the β-decay. The above authors have given an experimental proof, which tends to show that the β-decay is adiabatic. We shall present theoretical arguments to the same effect.

Disintegration of atomic nuclei by high-energy radiation: James B. Fisk (introduced by E. C. Kemble). In analogy with the process by which electrons are ejected from atoms by light waves, it has recently been possible to eject neutrons from a number of atomic nuclei by high energy gamma rays. This method has been used to produce disintegration of H^2 and Be, using natural radioactive sources of gamma radiation; and disintegration of Cu, Ag and Zn, and a number of other elements using the much more powerful gamma ray resulting from the process in which a proton is captured by the Li^7 nucleus. The Lithium gamma ray has energy of approximately 17 million electron-bolts, that is, approximately 9 M.E.V. more than the average energy of binding of a neutron to a nucleus. This type of disintegration has also been studied using the gamma rays produced in the bombardment of boron by protons. In this process the strongest gamma ray is 12 M.E.V., and the corresponding theoretical probability of disintegration is approximately twice that for the lithium gamma ray. This method of investigation of the properties of atomic nuclei is a very powerful one, and, as gamma rays of other energies become available through the use of higher voltage apparatus, should prove as useful as the corresponding photoelectric effect for atoms.

Flotation of some highly dispersed phases: **FRANK K. CAMERON** (introduced by Claude S. Hudson). It has been found that the phase rule applies to an aqueous suspension of a solid of colloid dimensions if the ion concentration at the surface be considered as the only significant varying intensity of the solid phase. When plotted against the pH of the liquid phase, boundary curves and transition points are found of the familiar types. An added reagent, if it dissolve with acquisition of a different sign, will be adsorbed by the solid, and if water-repellent, the adsorption complex may be floated. On these principles a simple technique has been developed for the rapid quantitative determination of a flotation agent for a colloid.

General relations governing the solubility of organic substances in water: **PAUL GROSS** (introduced by Roger Adams). Experimental determinations of the solubilities in water of a large number of slightly soluble organic substances, at different temperatures, have yielded data which on first inspection seemed devoid of regularity. While it has not been possible as yet to give anything approaching a complete quantitative picture of the factors involved, the influence of certain general factors has become apparent. These have been brought out by recalculating the solubilities as vapor solubilities after first demonstrating experimentally that the concept of the vapor solubility is applicable to systems of this type. These vapor solubilities show surprisingly simple quantitative correlations with the molecular volumes of the organic molecules. Treatment of the data for several series of related compounds in this way brings out the effect of polarity in the solute molecule on solubility and also shows the importance of London-Van der Waals type forces in determining the magnitude of the solubility values. The significance of the large values of the temperature coefficients of the vapor solubilities is also discussed.

Solid-liquid equilibrium and the interatomic potential curve for argon: **O. K. RICE** (introduced by Claude S. Hudson). Previous investigators, in attempting to find potential curves for interatomic forces, have generally assumed a simple combination of an inverse sixth power attractive potential and an inverse higher power or exponential repulsive potential, and have made use of equation of state data or the Joule-Thomson coefficient and theoretical considerations to fix the parameters. It is found in the present investigation that it is possible to make an estimate of the mutual potential of two argon atoms for a small range of interatomic distances close to the minimum of the potential curve by use of the melting parameters. The slope of this portion of the curve is considerably greater than anticipated, but it may be joined on smoothly and in a practically unique way to an inverse sixth power curve at larger interatomic distances. The whole may then be completed by use of data on the Joule-Thomson coefficient, giving a curve which is believed to be more nearly correct than any hitherto proposed.

The oxygenation of diisobutylene at elevated pressures: **R. W. BOST** (introduced by Roger Adams). The action of molecular oxygen on diisobutylene has been studied at pressures ranging from 100 to 150 pounds per square inch and at temperatures around 100° C. These studies were carried out in specially constructed bombs whose temperature could be controlled within narrow limits and were attached to a pressure-recording device, thus enabling one to follow the reaction closely. The reaction products consisted of organic peroxides, aldehydes, ketones and acids. When diisobutylene is oxygenated in the presence of solid potassium hydroxide, peroxides are absent.

Size of seed and other criteria of polyploids: **ALBERT F. BLAKESLEE** and **H. E. WARMKE**. For determination of the chromosomal constitution of members of a polyploid series, ultimate dependence must be had upon microscopic examination of their chromosomes. Two reservations to this criterion are (1) the fact that a plant may give a 4*n* count and yet be unbalanced in two sets to form a 4*n* + 1–1 individual and (2) the fact that under certain conditions, such as colchicine treatment, both 4*n* and 2*n* sectors as well as sectors with chromosomal deficiencies are common on the same plant. The difficulties involved in examination of chromosomes suggest desirability of short-cut methods of determination. The following criteria have been found useful in preliminary separation of the even-balanced 4*n* from normal 2*n* individuals and with some modifications are usable with other members of the polyploid series. (1) Larger pollen grains in 4*n* flowers. Presence of a few 1*n*-size grains common in tetraploids not yet explained. (2) Larger 4*n* seeds. (3) Larger stomata. (4) Leaves increased in width, thickness and depth of green color. (5) Larger size of floral parts. (6) Shorter, stouter fruits. For odd-balanced types (*e.g.*, 1*n* and 3*n*) criteria (3) to (6) are usable, but the proportion of aborted pollen grains is a better criterion. In a study of the effect of polyploidy upon the sex and sex mechanism of a series of dioecious plants, it is difficult with the female individuals to use the best criteria of polyploidy (actual chromosome determination and pollen size). Doubling chromosome number does not prevent the sex expression of maleness and femaleness in such species. For example, in hemp which had been treated with colchicine, 4*n* male flowers were determined, first by pollen size and later by chromosome counts in pollen mother cells. Females were determined provisionally by thickness of leaves, size of stomata on floral bracts (which appears a more reliable criterion than of those on leaves), but especially by the seeds, which were distinctly larger than those of 2*n* controls. Such large seeds of presumptive 4*n* females when pollinated by 4*n* males gave rise to male and female offspring, of which all the males were 4*n* and all the females appeared 4*n* by the tests already mentioned. An intersex plant was determined to be 3*n* by chromosome counts in pollen mother cells. Stomata on its floral bracts were intermediate in size between those of 2*n* and 4*n* individuals.

Further experiments on the behavior of the "dominant" lethal, I, of Neurospora: **B. O. DODGE.** Because a cell provided only with nuclei that carry the "dominant" lethal, I, can not develop vegetatively to any great extent, there has been some question whether it is possible to obtain asci homozygous for this factor. These experiments prove that occasionally ascocarps in which the asci are homozygous, II, for the lethal can be obtained. Another question arises as to whether interspecific crosses can be made when one of the parents carries this factor I. When *Neurospora tetrasperma*, the 4-spored species, carrying the lethal, I, is mated against *Neurospora sitophila*, the 8-spored species, the resulting asci so far obtained have been 8-spored, as might be expected because 8-sporedness is dominant over 4-sporedness. Some evidence had previously been obtained to indicate that this factor may revert or lose its power altogether to bring about abortion in heterozygous, Ii, asci. When the lethal was introduced in these interspecific crosses it was not effective in bringing about indurated ascus abortion in the first generation in these experiments.

(*To be concluded*)

PLACER MINING AND THE ANADROMOUS FISH OF THE ROGUE RIVER

By Professor HENRY B. WARD
UNIVERSITY OF ILLINOIS

THE wide-spread pollution of streams and lakes in the United States is well known and recognized not only by all students of natural history but by many others whose love of nature and contact with existing conditions have made them painfully conscious of the situation. The demand for correction or limitation of these conditions is based on the damage done to water supplies essential for the population in given areas, on the destruction of fish life and other aquatic organisms, both plant and animal, that play an essential part in the economy of nature, and on the serious limitation or total destruction of recreational opportunities connected with the water bodies involved.

Abundant evidence has been secured in specific cases to justify the complaints and to call for corrective legislation. The protection of drinking water supplies is generally acknowledged to be essential. Scientific studies have definitely connected the destruction of the fish life with the dumping of manufacturing wastes into various rivers or the discharge of large volumes of domestic waste in untreated sewage. Even before the condition of the water had become so marked as to deter adults or youths from utilizing streams or lakes for recreation, health boards had interdicted such practices on the basis of demonstrated contamination of the water. Increasing volumes of polluted water have become of such national concern that the last Congress devoted much time to the discussion of the problem, although unfortunately the emasculated measure adopted at the last moment was generally unsatisfactory and wisely vetoed by the President. One new phase in the relation between the fish fauna and the environmental conditions it encounters in a particular locality has been subjected to careful study with reference to a factor which appears not to have been investigated previously.

In many places the fish supply of our rivers constitutes a natural resource of high value, though often overlooked and sadly neglected. Recently attention has been directed to the influence of local practises on the welfare of the fish in the stream. The Rogue River in southwestern Oregon has long been famous for its steelhead and salmon. Within recent years the run of these fish has fallen off materially, and some have attributed the decline to an increased activity in placer mining which adds to the stream a considerable volume of earthy material washed down from the hillsides of the valley. On the other hand, the gold-bearing soils constitute a valuable natural resource, the development of which has contributed materially to the welfare of the area and of the state. This conflict of interests led to legal controversy in which the need for more accurate determintaion of the facts involved became evident.

I was asked to make an independent and all-sided study of the river in order to ascertain the accuracy of the complaint, the extent and character of any damage done to the fish, and when the damage was determined to consider how the placer mining industry might modify its practises for the protection of the fish. I was assured of perfect freedom in carrying out my studies and in publishing the results. The report[1] just completed contains some biological observations of such character as to justify their presentation here in brief.

The charge brought against the placer mining industry maintained that it discharged into the river an amount of waste inimical to the welfare of the fish. No one doubted that during the active season the run-off from placer mining added to the stream a considerable amount of silt and that material in miners' terminology was "waste." Superficial inspection had convinced people generally that the stream "looked bad," but in the complaint no real evidence was offered as to the effects on the fish. The rusty-red, muddy water made so unfavorable an impression on the observer that it seemed to justify the complaint. Indeed, at the start I was inclined to regard conditions as at least somewhat unfavorable for the fish.

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[1] "Placer Mining on the Rogue River, Oregon, in its Relation to the Fish and Fishing in that Stream. An ecological study made for the Oregon State Department of Geology and Mineral Industries." Bull. No. 10.

The question of fundamental importance is to determine what kinds of material are actually dangerous or destructive and as such should be rigorously prohibited from discharge in untreated condition. On the other hand, it is clear that with every rainstorm large quantities of earthy matter from fields, hillsides and forests are washed into the stream and serve to increase the natural load picked up by the waters in their normal course through the land. In many regions the quantity of material normally carried by a stream is large, and its character such that some part remains in suspension almost indefinitely.

The magnitude of this load is well indicated by Table 1, which cites data of normal turbidity in various streams not subject to the influence of mining, as recorded by various agencies. The Oregon streams are moderately loaded; the last two rivers represent extreme conditions.

TABLE 1

AMOUNT OF SILT CARRIED BY CERTAIN RIVERS

	Parts per million	Average turbidity
Columbia River at Cascade Locks, Oregon	137	27
Klamath River at Klamath Falls, Oregon	146	...
Umatilla River at Umatilla, Oregon	247	79
Rogue River at Copper Canyon, Oregon (est.)	321	...
John Day River at McDonald, Oregon ..	324	245
Snake River at Weiser, Idaho	324	80
Owykee River at Owykee, Oregon	305	167
Rio Grande	14,840	...
Colorado River (flood conditions)	21,500	...

In my own experience I have seen rivers in Alaska which carry even larger quantities of such materials than the Oregon rivers, but in all these streams various types of fish are found regularly and in regions remote from the interference of population the fish fauna may be abundant. This, together with much other evidence, emphasizes the fact that at least so far as maintaining fish life is concerned, under natural conditions the quality of the material appears to be of first importance and the quantity of secondary character. That the same proviso applies also to man is evidenced by the serious epidemics of typhoid fever shown to have been due to the discharge at a single point of a relatively small volume of contaminated material, whereas the heavily silted waters of the Missouri, the Platte and other streams are not unsafe for drinking water because of the presence of the large quantities of earthy materials in solution or suspension.

A precise determination of the facts in the case of the Rogue River was sought first through a study of the river itself. This was carried out during two periods. In one the river was in its maximum low-water condition; the other period came after melting winter snows and early rains had swollen the stream, not to flood conditions but to the level of average maximum high water. In the first period placer mining activity had entirely ceased some time before, so that the river was clear of sediment; conditions within the stream could be well observed and those above low-water level, on the banks and in shallow areas accurately determined.

During the high-water conditions placer mining was being carried on at its maximum. The run-off from these operations was discharged into smaller tributaries or directly into the Rogue River itself. It was important to determine both the kinds of materials flushed into the stream in this manner and the quantity added to the river by all these undertakings. Early in the study it became apparent that the entire region was subject to periods of heavy rain and irregular as well as marked fluctuation in the water level of all streams. As a result the turbidity of the water and its load of materials in solution and suspension fluctuated naturally within wide limits. This was shown by government records covering a period of eleven months made at a point on the Rogue well above all placer mining. Natural erosion due to climatic factors tears down the hills and loads the streams in the same way and with the same materials that are contributed by the artificial erosion of placer mining.

When the study was extended to the materials involved, further observations disclosed that deposits from placer mining operations did not differ in chemical or physical character from those laid down by flood waters. Records were taken continually through the mining season at Grant's Pass above the influx of all placer mine run-off and at Agness below the addition of the last material from placer mining. These were tabulated and showed that while the maximum turbidity of the Rogue River water varied irregularly, the highest figures at one place were substantially the same as those at the other place. In other words, the maximum load carried by the river under present placer mine operations is not greater than that due at times to natural erosion.

The present extent of placer mining is clearly not equal to that undertaken by the first operations in 1850 to 1860 and at some periods thereafter. Then the work was prosecuted with great activity induced by the early discoveries and the highly profitable results of the original undertakings in this field. If present conditions are unfavorable for the fish there they must have been even more destructive at that time. The records available do not bear out this relation.

In the Rogue River itself the salmon run was maintained at a high level during the earlier periods of marked activity in placer mining. The reduction in the run of the fish was most marked during the period between that earlier time of placer mining activity and the very recent years in which enhanced value of gold has led to a partial revival of the industry in that region.

A study of the materials in the run-off disclosed no substance inimical to the welfare of the fish, either young or old. In a recent bulletin[2] Dr. M. M. Ellis has given an analysis of the types of erosion materials and their effect on conditions of fish existence. He pointed out that in no way has erosion silt a known destructive influence but suggests that by forming a pollution blanket on the bottom and by increasing turbidity erosion silt and other suspensoids may have a critical limit. These two features were studied carefully in connection with the conditions in the Rogue River system.

Observations on the river under low-water conditions failed to reveal the presence of any continuous or impermeable layer of erosion materials which could serve as a blanket, cover fish foods or spawning grounds or in any way injure adults or young of these anadromous fish during the periods of their life history spent in the river. A further examination of the literature reveals no support for the popular opinion that sawdust, silt and other solid particles of the type found in the Rogue River can clog the gills and kill the fish by suffocation. Past experiments with such materials gave uniform evidence that natural substances are not the cause of mechanical injuries and do not clog the gills of the fish or kill the young.

To designate placer mine run-off as pollution is unjustified. While it may be called "waste" since it is discarded in the process, it contains only natural soil constituents and no foreign substances. None of the unstable materials or toxic substances which are common in domestic sewage or industrial wastes are found in the placer run-off in this valley. So long as the process remains as it now is the run-off can not pollute or contaminate the water of the river. The color comes from ferric compounds which are not harmful to the fish; it is persistent and contributes to the opacity of the water and thus to a degree offers protection against the wiles of the angler. At points where the water was too dense to see fish, it really contained very little sediment.

The very fine silt may be related to the primitive food supply of the young fish and have thus a favorable rather than an unfavorable influence. The Wisconsin survey has shown that colloidal organic material collects on minute solid particles to furnish culture media for aquatic bacteria. Very young fish from muddy waters, which I have often dissected under the microscope, have the gut well filled with mud. The organic materials ingested with the silt may be a valuable element in fish nutrition. This feature certainly deserves careful investigation.

In order to make the conclusions more convincing Dr. L. E. Griffin was secured to carry out in his laboratory at Reed College some experiments on young trout and salmon. The results of the experiments are reported in detail in Appendix B of my report just published. Young fish were held for three to four weeks in tanks through which was circulated water containing in constant suspension more than 1,000 parts per million of mud taken from placer mine areas in the Rogue River Valley. This is far more than the maximum amount (440 ppm) actually found in Rogue River water taken in at Agness. Yet the fish remained active and the percentage loss of life was less than expected among fish held in confinement. The condition of the fish was apparently slightly better than that of controls from the same source kept in tanks of clear water at the same place during the same period.

An important contribution to the report is Appendix A on "Rogue River Turbidity," by Arthur M. Swarbley, geologist in the Oregon State Department.

SCIENTIFIC EVENTS

THE NATIONAL GEOLOGICAL SURVEY OF CHINA

DR. GEORGE B. CRESSEY, chairman of the department of geology and geography of Syracuse University, has received letters from Peiping and Chungking concerning the present status of the National Geological Survey of China.

Some three years ago the headquarters of the survey were moved from Peiping to the new buildings in Nanking. With the evacuation of that city a year ago, the survey moved first to Changsha and more recently to Chungking. All the maps, rare books and type specimens in Nanking were packed for storage and are supposed to be safe. Some of the ordinary reference books, a large part of the survey's publications and the specimens under study were not shipped until the last moment and only a portion of them reached the interior in safety. Most of the apparatus thus sent away was damaged. The museum specimens were only partially packed and were either transported to the countryside outside of Nanking or left in the building. It is feared that all have been lost.

Dr. Wong Wen-hao is now at the survey headquarters in Chungking. One member is in Hongkong looking after printing arrangements, an additional office has been established in Yunnan, and the work of the Cenozoic Laboratory in Peiping is proceeding without interruption under the direction of Drs. Weidenreich and W. C. Pei. Dr. Grabau continues his residence in Peiping, where he has completed the fourth volume on his pulsation theory.

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[2] U. S. Bureau of Fisheries, *Bull.* 22: 1937.

Despite the tremendous losses which the survey has suffered, the staff has actually been increased and the work expanded. Intensive study is being given to the economic geology and mineral resources of the southeastern provinces.

THE FATE OF AUSTRIAN SCIENTIFIC MEN

The faculty of medicine of the University of Vienna has suffered severe losses. It is estimated by the Berlin correspondent of the *Journal* of the American Medical Association that about half of the assistant professors and instructors holding office at the time the Austrian republic was absorbed by the German Reich have lost their positions. The Jewish element has been prominent among these groups, whereas but few Jews have served as full professors in recent years.

The *Journal* gives the following particulars in regard to some of the better known faculty members: Professor Egon Ranzi, ordinarius in surgery and son-in-law of the Viennese surgeon, Anton Eiselsberg, has been forced to relinquish the directorship of the university's surgical clinic and has been retired on a pension because he had been an adherent of Schuschnigg. Professors Leopold Arzt and Wilhelm Kerl, both of them "Aryans" and ranking dermatologists, met the same fate at Ranzi for like reasons. Professor Arzt, decided anti-Semite, ardent proclerical and nephew of a late archbishop of Vienna, was in custody for a short time. Ernst P. Pick, professor of pharmacology and a pupil and successor of H. H. Meyer, was forced to retire on account of being a Jew. The physiologist Arnold Durig was also retired for reasons unknown.

As is generally known, Professor Otto Loewi, of Graz, who not long ago shared the Nobel prize with Sir Henry Dale, of London, has been deprived of his post and has spent some time in custody; he has lately been given his freedom. One of the younger psychiatrists, Professor Otto Kauders, also of Graz, has been dismissed, ostensibly on racial grounds. Foremost among Viennese psychiatrists and neurologists to be affected by the new régime was Sigmund Freud, who has subsequently been received with great honors in London. Hans Hoff, one of the younger psychiatrists, has emigrated to the United States. Professor Otto Marburg, ordinarius in neurology, has been deprived of his position; Erwin Stransky has suffered a like fate.

Among the internists who have lost their positions are G. Hitzenberger, radiologist; David Scherf, cardiologist; Julius Bauer, best known for his research on endocrinology and on constitution; Karl Glaessner, Otto Porges and Walter Zweig. The last named was a pupil of Ismar Boas. The tragic death of Professor Boas has previously been reported. He had made Vienna his refuge from Nazi Germany. After the annexation of Austria he ended his life with an overdose of barbital. Still other faculty members to be dismissed were Moriz Oppenheim, dermatologist; Gottwald Schwarz, roentgenologist; Josef Friedjung, pediatrician; Richard Wagner and Heinrich Kahr, gynecologists, and Emil Froeschels, research phoniatrician. Professor Heinrich von Neumann, the otologist, a "non-Aryan," was under arrest until the successful intercession of his patient, the Duke of Windsor. There have been other suicides in addition to Professor Boas: the pediatrician, Professor Wilhelm Knoepfelmacher; seventy-four-year-old Professor Oskar Frankl, gynecologist, and the dermatologist, Gabor Nobl, known for his injection therapy of varices.

The correspondent points out that in view of the circumstances this report can make no claim to completeness. It does, however, provide an idea of how the change in the political status of Austria has affected faculties of medicine.

GIFTS TO COLUMBIA UNIVERSITY FOR SCIENTIFIC RESEARCH

Gifts to Columbia University aggregating $403,792 have been announced. The contributions, received during the past four months, will be applied largely to the support of research in medicine, chemistry, biology and other sciences.

The Rockefeller Foundation gave $111,750, of which $100,000 will be devoted to teaching and research in neurology over a five-year period. The remainder will be utilized as follows: Research on the constitutional aspects of disease, $7,000; studies of the common cold, $2,750; research in chemical embryology, $2,000.

The Carnegie Corporation of New York contributed $64,460, of which $50,000 is for the endowment of the program of graduate medicine at the School of Medicine; $8,260 is for chemical research in the department of biological chemistry; $2,500 is for a study of young workers in a metropolitan area under the direction of the Institute of Educational Research at Teachers College; $1,550 is for research in statistical analysis; $1,500 for research on deficiency diseases in certain animals, and $650 for research in biochemistry.

The John and Mary R. Markle Foundation gave $54,800, of which $24,600 is for work at the Institute of Cancer Research on biological effects of radiation, $26,200 for establishment of a free-ranging breeding colony of primates in Puerto Rico, and $4,000 for research in the department of pathology on cell proliferation in arteriosclerosis.

Other contributions of $5,000 or over for scientific work are:

Three anonymous donors, through the Alumni Fund, for the School of Engineering, $50,000.

The Josiah Macy, Jr., Foundation, $2,100 for research in the department of zoology on the origin of hereditary abnormalities and lethal effects in early vertebrate embryos; $2,160 for the study of obesity in childhood; $3,600 for a study of primates; $5,000 for investigations in the department of pathology on the relation of lipoids to the processes of growth and aging; $5,600 for investigations in the department of pathology on cell proliferation in arteriosclerosis, and $7,800 for the compilation and publication of results of investigations of psychosomatic problems in the department of medicine—a total of $26,260.

An anonymous donor for research at the Institute of Cancer Research, under the direction of Dr. Francis Carter Wood, $20,000.

The United States Public Health Service to the *American Journal of Cancer*, $8,500.

The Florida Citrus Commission, for research on the nutritional aspects of citrus fruits, $5,000.

AWARDS OF THE AMERICAN SOCIETY OF MECHANICAL ENGINEERS

A LIST of the 1938 honors and awards, to be presented on December 6 to members and junior members of the American Society of Mechanical Engineers at the fifty-ninth annual meeting of the society in New York City, has been announced by C. E. Davies, secretary of the society. An attendance of more than 3,000 engineers from all parts of the United States and Canada is expected at the meeting. The awards are as follows:

Awarded for some great and unique act of genius of engineering that has accomplished a great and timely public benefit, the Holly Medal will be given to Francis Hodgkinson, professor at Columbia University and consulting engineer, 138 E. 36th Street, New York City, for "meritorious services in the development of the steam turbine."

Bestowed for an outstanding contribution to permanent engineering literature, the Worcester Reed Warner Medal will be presented to Lawford H. Fry, railway engineer, Edgewater Steel Company, Pittsburgh, Pa., for "written contributions relating to improved locomotive design and utilization of better materials in railway equipment."

Presented annually for an original paper or thesis of exceptional merit presented before the society, the Melville Medal for 1938 will be awarded to Alphonse I. Lipetz, chief consulting engineer in charge of research, American Locomotive Company, Schenectady, N. Y., for his paper on "The Air Resistance of Railroad Equipment."

For outstanding achievement in mechanical engineering for 1938, the Pi Tau Sigma Medal will be given to Wilfred E. Johnson, engineer with the General Electric Company, 1605 Winter Street, Fort Wayne, Ind. Mr. Johnson was picked from among hundreds of candidates proposed by engineering schools, the local sections of the American Society of Mechanical Engineers and members of Pi Tau Sigma, engineering fraternity.

The Junior Award will be presented to Arthur C. Stern, consulting engineer, 928 Broadway, New York City, for his paper "Separation and Emission of Cinders and Fly Ash."

The Charles T. Main Award of $150 for student engineers will be presented to Edward W. Connolly, 12347 Monica Avenue, Detroit, Mich., graduate of the University of Detroit, for his paper on "Economic Limitations in Engineering Design—with Concrete Examples."

The Postgraduate Student Award will be given to Marshall C. Long, 928 W. 34th Street, Kansas City, Mo., graduate student at Princeton University, for his paper on "An Investigation into the Angular Characteristics of an Adjustable Blade Current Meter."

The Undergraduate Student Award will be bestowed upon Donald C. McSorley, 434 S. Magnolia Avenue, Lansing, Mich., formerly of Michigan State College, for his paper on "Humidity Insulation."

THE SEMI-CENTENNIAL MEETING OF THE GEOLOGICAL SOCIETY OF AMERICA

As has already been reported in SCIENCE, fifty years of progress in the science of geology will be celebrated at the semi-centennial meeting of the Geological Society of America, which will be held at the Waldorf-Astoria Hotel, New York City, on December 28, 29 and 30. Dr. Arthur L. Day, of Washington, D. C., is president of the society.

A special anniversary day program on Friday, December 30, will describe the contributions made by geology to the development of the natural resources of the United States. Representatives of the major fields of geology, including mineralogy, economic geology, paleontology, seismology and petrology, will report advances already made and outline problems yet to be solved.

Professor Herman Leroy Fairchild, of the University of Rochester, who is now eighty-eight years old and the only surviving member of the organizing committee which met at Ithaca, N. Y., in December, 1888, to found the society, will participate. Six of the one hundred and twelve original fellows who are still living will be among the guests. They are, in addition to Professor Fairchild: Dr. Nelson H. Darton, U. S. Geological Survey; Dr. William F. E. R. Gurley, Chicago; Dr. Robert T. Hill, Dallas, Texas; Professor Frederick W. Simonds, University of Texas; Dr. Edward O. Ulrich, U. S. National Museum.

The Paleontological Society, the Mineralogical Society of America, the Seismological Society of America and the Society of Economic Geologists, associated societies, will hold their annual meetings as a part of the three-day program and will participate in the exhibits, scientific sessions and annual dinner of the Geological Society. Luncheons are planned by the Mineralogical Society on Wednesday, December 28, and by the Society of Economic Geologists on Thursday, December 29.

Lay explanations of the role of geology in everyday life and its contributions to the development of the United States will be presented over the radio during the meeting in a series of broadcasts sponsored by the society. More than fifty exhibits, dramatizing the work of geology in all its branches, are being arranged by Dr. E. H. Colbert, of the American Museum of Natural History, chairman of the exhibits committee.

The presidential address will be delivered by Dr. Day on Thursday night, at a special session in the American Museum of Natural History, Central Park West and 77th Street. The annual smoker will follow Dr. Day's address. Dr. Day retires from office at the close of the meeting and will be succeeded by a fellow whose election will be announced during the meeting.

More than a hundred scientific papers reporting the progress of research on a variety of geological subjects will be given during the morning and afternoon sessions of December 28 and 29. The meeting will close on Friday night, December 30, with the annual dinner.

The program will include the presentation of the Penrose medal, given for "eminent research in geology" to a geologist to be named that night. It will be the tenth award of the medal since it was established under a bequest by the late Dr. R. A. F. Penrose, Jr., in 1927. Dr. T. Wayland Vaughan, of Washington, D. C., first vice-president of the society and chairman of the medal committee, will introduce the medalist. Dr. Day will make the presentation.

Geology in and around New York City will be studied by visiting geologists during a series of five excursions on Saturday. Open house will be maintained during the meeting at the national headquarters of the Geological Society at 419 West 117th Street. Professor Paul F. Kerr, of Columbia University, general chairman, is being assisted by a committee composed of forty-two local geologists.

Dr. Day is chairman of the special committee that is arranging the semi-centennial observance. Assisting him are Dr. Charles P. Berkey, of Columbia University, secretary of the society; Professor Chester R. Longwell, of Yale University; Professor Donald H. McLaughlin, of Harvard University; Professor Arthur F. Buddington, of Princeton University, and Joseph Stanley-Brown, of Kew Gardens, L. I., chairman of the finance committee.

RECENT DEATHS AND MEMORIALS

Dr. Allen Rogers, supervisor of the department of chemical engineering at Pratt Institute, Brooklyn, since 1920, died on November 4 at the age of sixty-two years.

Professor Leonard Stanley Dudgeon, professor of pathology at the University of London, dean of St. Thomas's Hospital Medical School and director of pathology and bacteriology at the hospital, died on October 22.

A correspondent writes: "The death at the age of thirty-one years has been announced of L. G. Schnirelmann, one of the foremost mathematicians of the younger generation of the U.S.S.R."

An inscribed stone has been fixed by the London County Council at No. 32, Soho Square, W.I., London, recording the fact that Sir Joseph Banks, president of the Royal Society, and Robert Brown and David Don, botanists, lived at the house which formerly stood on the site, and that the Linnean Society met there from 1821 to 1857.

On the occasion of the Virginia convention of the American Association for the Advancement of Science, which will meet in Richmond from December 27 to 31, the Virginia Section of the American Chemical Society has taken steps to give honor to Virginia's first state geologist, W. B. Rogers, for whom Mount Rogers in southwest Virginia is named. The section has been requested by officials of the national organization to sponsor a tour which will include a visit to White Top and Mount Rogers. One of the proposals for the memorial is the erection of a tower of native rock on the summit of Mount Rogers, which commands a view of five states. Dr. Rogers took part in the formation of the Association of American Geologists and Naturalists. He was named president of this group in 1848, when the society was transformed into the American Association for the Advancement of Science. He was elected president of the American Association in 1876.

SCIENTIFIC NOTES AND NEWS

Dr. Robert W. Wood, who retired this year from the professorship of experimental physics at the Johns Hopkins University, has been awarded the Rumford Medal of the Royal Society in recognition of his work in physics and optics. Dr. Wood is a foreign member of the society. The Rumford Medal was founded by Benjamin Thompson Rumford, who died in 1814.

Dr. William Lowe Bryan, president emeritus of Indiana University, previously professor of philosophy at the university, has sent in his resignation as a trustee of the Carnegie Foundation for the Advancement of Teaching. He will attend his last meeting of the foundation in New York on November 16. Dr. Bryan was appointed a trustee of the foundation in 1910, succeeding Woodrow Wilson, who had resigned to become governor of New Jersey.

Major General William H. Tschappat, formerly chief of ordnance of the U. S. Army, who retired from active service on June 2, has been elected an honorary member of the American Society of Mechanical Engineers.

J. R. Townsend, materials standards engineer of the Bell Telephone Laboratories, New York City, has been elected a member of the executive committee of the American Society for Testing Materials. He takes the place vacated by Allen Rogers, who recently resigned because of ill health and who died on November 4.

Presentation of the Chemical Industry Medal of the Society of Chemical Industry, awarded annually for valuable application of chemical research to industry, was made to Dr. J. V. N. Dorr, president of the Dorr Company, at a joint meeting of the American Section of the Society of Chemical Industry and the American Chemical Society at the Chemists' Club on November 4. The award was made to Dr. Dorr, "in recognition of his inventions and subsequent worldwide introduction of apparatus and processes in many chemical, metallurgical and sanitational operations which have made possible low cost production on a large scale." The presentation was made by Victor G. Bartram, of Montreal, Canada, president of the Society of Chemical Industry. Dr. Howard C. Parmelee, vice-president of the McGraw-Hill Publishing Company, spoke on the life and accomplishments of the medalist. Dr. Wallace P. Cohoe, chairman of the American Section of the Society of Chemical Industry, presided.

The Clement Cleveland Medal "for outstanding work during the year in the campaign to control cancer" was presented to the National Association of Science Writers at the twelfth annual dinner meeting of the New York City Cancer Committee, which was held on November 2. Mrs. Robert G. Mead presented the medal to William L. Lawrence, a member of the staff of *The New York Times*, who was designated by Thomas Henry, president of the association, to accept the medal in behalf of his associates.

Sir D'Arcy Power was elected president of honor of the International Society of Surgery at the eleventh meeting of the International Congress of Surgery held at Brussels last month. He was one of the founders of the society and was for many years the honorary local secretary for Great Britain and Ireland.

Nature writes: "The impending retirement of Sir Daniel Hall from the directorship of the John Innes Horticultural Institution will presumably close his very long connection with agricultural administration and research. From the time when he was the first principal of the South Eastern Agricultural College, Wye, and throughout his directorship of the Rothamsted Experimental Station, his tenure of office as principal scientific adviser to the Ministry of Agriculture and Fisheries, and lately as director of the John Innes Institution, Sir Daniel has impressed all by his knowledge, his sound judgment and tact, and not least by his great ability as a writer and speaker."

Dr. George C. Shattuck has been promoted to a clinical professorship of tropical medicine in the Harvard Medical School and the Harvard School of Public Health.

Professor F. F. Nord, of the University of Berlin, has been appointed professor in organic chemistry at Fordham University.

Dr. Alfred F. Huettner has resigned his professorship at Washington Square College, New York University, and has become associate professor in biology at Queens College, Flushing, N. Y.

Dr. John J. Livingood, who has been working in cooperation with Professor E. O. Lawrence, of the University of California, with the cyclotron, has been appointed instructor and tutor in physics at Harvard University.

Dr. Soma Weiss, associate professor of medicine at the Harvard Medical School and assistant director of the Thorndike Memorial Laboratory at the Boston City Hospital, has been appointed physician-in-chief of the Peter Bent Brigham Hospital, to succeed Dr. Henry A. Christian, who has resigned.

Dr. Gano Dunn, president of the J. G. White Engineering Corporation, has been elected director of the RCA Manufacturing Company.

Dr. Robert B. Sosman, since 1928 physical chemist of the Research Laboratory of the United States Steel Corporation, Kearny, N. J., has been made a member of the Bartol Research Foundation Committee of the Franklin Institute.

Thomas G. Stitts, formerly in charge of research and service work in the cooperative division in dairying of the Farm Credit Administration, has become head of a new subdivision of cooperative research and service of the division of research.

Dr. Paul Dever Miller, assistant in the departments of chemistry and physics of the Ohio State University, and Dr. George B. Waitkins, associated with the Solvay Process Company and the Agfa Ansco Company, have joined the technical staff of the Battelle Memorial Institute, Columbus, Ohio. Dr. Waitkins will be concerned with problems in industrial organic chemistry and Dr. Miller with problems of physical chemistry.

Dr. Harold St. John, of the Bishop Museum and the University of Hawaii, returned in September to Honolulu from a four-months botanical expedition to Rotuma Island under the auspices of the Carnegie Corporation. Rotuma is an isolated volcanic island in the South Pacific Ocean, eight miles long, 860 feet high. It is populated by a handful of whites and 2,900 native Polynesians. Its flora was completely unknown. Dr. St. John returned with collections of the native and introduced plants and of the economic plants used by the natives. The collections total 5,000 sheets and include many new species.

Dr. B. E. Dahlgren, chief curator of botany at the Field Museum of Natural History, has returned from a brief visit to northern Brazil. He brings material required for the preparation of proposed dioramas showing groups of tropical plants in scenes reproducing their native habitats. Studies and collections were made of palms and other plants in the state of Para along the Amazon and Tapajoz Rivers. Besides plant material, he obtained an extensive series of photographs which will guide the preparators in reconstructing the South American landscapes and preparing the ecological groups of plants, which are to be features of the Hall of Plant Life.

Dr. Myron Gordon, who from 1925 to 1937 was in charge of the fish genetics laboratory of the department of zoology of Cornell University, has been appointed a fellow of the John Simon Guggenheim Memorial Foundation for the year beginning on October 1. He will study the geographical distribution and variation of the platyfishes of the streams of the Atlantic drainage of Mexico. Stocks of all the species will be brought back to reestablish the genetics experiments formerly conducted at Cornell University.

In connection with the recent allotment of funds to the Geological Survey by the Public Works Administration for studies of strategic minerals, D. F. Hewett spent from October 5 to 7 in field conferences with H. G. Ferguson, Ward Smith and R. M. Dreyer, who are engaged in studies of nickel deposits in the Table Mountain district, tungsten deposits in the Lovelock quadrangle, and mercury deposits in the Goldbanks district, Nevada, respectively. Later Mr. Hewett engaged in a brief review of the geology of the Death Valley region, in company with L. F. Noble.

On sabbatical absence from Smith College for the first semester are: Gladys A. Anslow, professor of physics; Dorcas Brigham, assistant professor of botany; Elizabeth F. Genung, associate professor of bacteriology, and Caroline E. Heminway, assistant professor of geology; on sabbatical absence for the second semester will be: Gilbert H. Ayres, associate professor of chemistry; Robert F. Collins, associate professor of geology. On leave of absence for the year is Margaret Kemp, assistant professor of botany.

Professor S. O. Mast, of the Johns Hopkins University, will deliver on November 21 the second William Keith Brooks lecture at Greensboro College, North Carolina. The first lecture was given by Professor A. S. Pearse, of Duke University.

Dr. A. Ashley Weech, associate professor of diseases of children, College of Physicians and Surgeons, Columbia University, will deliver the second Harvey Society lecture of the current series at the New York Academy of Medicine on November 17. He will speak on "The Significance of the Albumin Fraction of Serum."

Dr. Charles F. Brooks, director of the Blue Hill Observatory of Harvard University, spoke before the American Geographical Society of New York on November 1 on the September hurricane and on the methods of predicting such storms.

Dr. Oscar Riddle, of the department of genetics of the Carnegie Institution at Cold Spring Harbor, gave an address at Queens College, Flushing, N. Y., on the evening of October 26. He spoke on "The Life-Sciences and Modern Man."

Dr. Charles Palache, emeritus professor of mineralogy and curator of the mineralogical museum at Harvard University, addressed the Boston Mineral Club on November 1 at the lecture hall of the Geological Museum, Harvard University. The title of his lecture was "Forty Years of Mineral Collecting around Boston."

Professor Philipp Frank, of the German University of Prague, lectured at the Iowa State College on November 7 under the auspices of the Research Council on "Philosophical Interpretations and Misinterpretations of the Quantum Theory" and under the sponsorship of Sigma Xi on "Modern Physics and Common Sense." Dr. Harold T. Stearns, senior geologist of the U. S. Geological Survey, lectured on October 13 and 14 on the geology and volcanology of Hawaii.

Dr. Claude E. ZoBell, professor of marine microbiology at the Scripps Institution of Oceanography, La Jolla, Calif., and Professor B. M. Duggar, of the department of botany of the University of Wisconsin, were the guest speakers at the autumn meeting of the

North Central Branch of the Society of American Bacteriologists held in Madison on October 21. Dr. ZoBell gave an illustrated lecture on "The Occurrence and Importance of Bacteria in the Sea"; Professor Duggar spoke on "Some Effects of Radiations upon Microorganisms."

THE fortieth annual meeting (the 225th regular meeting) of the American Physical Society will be held at the National Bureau of Standards in Washington, D. C., on Tuesday, Wednesday and Thursday, December 27, 28 and 29. Dr. Lyman J. Briggs, director of the National Bureau of Standards and president of the society, will give an address on Wednesday afternoon on "The National Standards of Measurements." This will be followed by an inspection of the standards in the laboratories. The program will include a joint dinner with the American Association of Physics Teachers on Wednesday evening. Headquarters of the society will be at the Wardman Park Hotel.

THE North Midwest Section of the Society for the Promotion of Engineering Education held its fourth annual meeting at the Michigan College of Mining and Technology at Houghton, Mich., on October 7 and 8. Dr. J. H. Mathews, head of the department of chemistry at the University of Wisconsin, gave an illustrated public lecture on "The Scientific Detection of the Criminal"; Professor M. L. Enger, dean of the College of Engineering of the University of Illinois, discussed "Academic Salaries"; group conferences and inspection trips were also included on the program. Professor E. B. Kurtz, of the State University of Iowa, will act as chairman of the 1939 meeting, which will be held at the university in Iowa City. He succeeded Professor George W. Swenson, of the Michigan College of Mining and Technology.

THE first forum meeting of the American Institute, New York, on "The Impact of Science on Society," was held on Thursday, November 10. Dr. Howard W. Haggard, who has been asked to serve as permanent chairman for the forums, presided. The subject of the first meeting was "Does Longer Life Mean More Happiness?" Dr. Alfred J. Lotka, president of the Population Association of America, assistant statistician of the Metropolitan Life Insurance Company, was the principal speaker; Dr. Louis I. Dublin, of the Metropolitan Life Insurance Company; Dr. Daniel Prescott, of Rutgers University, and Dr. Mordecai Ezekiel, of the Social Security Board, joined in the discussion.

LECTURES announced for the coming season by the Lancaster Branch of the American Association for the Advancement of Science are as follows: October 27, "The Gates of the Antarctic," by Dr. Robert Cushman Murphy, curator of oceanic birds, American Museum of Natural History; November 17, "How Fast Can You Read?," by Dr. Charles H. Judd, director of education for the National Youth Administration, previously professor of education and head of the department of psychology, University of Chicago; December 5, "The Magic of Fluorescence," by Dr. H. H. Willard, professor of chemistry, University of Michigan; January 19, "Is there Telepathy?," Dr. Joseph Jastrow, emeritus professor of psychology, University of Wisconsin, speaker on the National Broadcasting Company Network; February 9, "Chemical Secrets in Plant Growth," by Dr. P. W. Zimmerman, plant physiologist, the Boyce Thompson Institute; March 9, "Dairying Down Under," by Dr. R. B. Stoltz, chairman of the department of dairy technology, the Ohio State University; April lecturer to be announced.

ANTI-CANCER week will be celebrated in France from November 23 to 30, under the auspices of the International Union against Cancer, of which Senator Justin Godart is president. It is planned to commemorate during the week the discoveries of x-rays and radium and the developments in physics following the discovery of the electron and Hertzian waves. The program is divided into the four following sections: 1. Physics of the Electron. 2. Physics and Biological Action of X-rays. 3. Physical and Biological Studies on Radioactivity. 4. Physical and Biological Studies on the Hertzian or Short Waves. Dr. Jean Perrin, professor of physics in the University of Paris, will preside.

THE *British Medical Journal* states that the twenty-sixth French Congress of Medicine, which was to have been held at Marseilles on September 26, was postponed until November 10 to 13. The following congresses which were to have been held this month have been indefinitely postponed: the twenty-fifth French Congress of Hygiene, the fourth annual Congress of French-speaking Electroradiologists and the Franco-Yugoslav Medical Congress. The next congress of the Latin Medical Press, which was to have been held at Lisbon this year, has been postponed until the end of next summer.

THE Public Works Administration has appropriated $403,100 for the improvement of national parks in California. Yosemite National Park and Lassen Volcanic National Park received $202,100 and $76,500, respectively, with smaller allocations made to Sequoia and General Grant national parks and Death Valley and Lava Beds national monuments. The total allotment for the National Park Service amounted to $2,000,000.

DISCUSSION

EPIDEMIOLOGY OF SAINT LOUIS ENCEPHALITIS[1]

PREVIOUS studies of the 1933 epidemic of St. Louis encephalitis failed to reveal a "concentration of cases in any sharply localized section of the city and suburbs."[2] By a statistical method which will be described in detail elsewhere it has been possible to detect a concentration of cases in a number of areas in St. Louis City and County for the epidemics of 1933 and 1937. Briefly the method consists of plotting on a given map not only the encephalitis cases but also an additional number of control cases. The control cases in the present study were taken from the only two sources known to be available.

The first controls were from general mortality records on file in the departments of vital statistics of the county and city. The sample consisted of the home addresses of all persons dying in St. Louis City and County in 1935 who were 5, 15, 25, 35, 45, 55, 65, 75, 85, 95 years of age. The second control series was taken from the city and county directories of the appropriate years so that 22.5 per cent. of the home addresses were from the county and 77.5 per cent. from the city (estimated population of county and city). Sampling was effected by selecting home addresses situated in a constant position on successive or alternate pages of the directory (*e.g.*, first home address in upper right-hand corner, etc.). There were 1,212 home addresses in the mortality sample, 2,453 in the directory samples, 1,130 reported encephalitis cases in the 1933 epidemic and 518 reported cases in the 1937 epidemic. The mortality and directory samples of populations from the twenty-six health districts in St. Louis, eighteen incorporated and twenty-one unincorporated communities of St. Louis County were tabulated and tests of homogeneity calculated.[3] Using the chi-square test no lack of homogeneity between the two control series was detected and the two control series were further checked by comparing the variation of the sampling per district and community with the United States Census figures for 1930. The next step was a systematic canvass of the map with a compass constructing circles with half-mile radii. In the area of each circle a test was made to determine whether a statistically significant preponderance ($P = 0.01$ or less) of control over encephalitis cases or *vice versa* occurred. Thus it was possible to disregard city and district lines and to shade those areas with a preponderance of encephalitis and to cross-hatch those in which a significant scarcity of encephalitis occurred. Statistically significant concentrations of reported encephalitis cases occurred in the two epidemics. In both epidemics the disease appeared first and simultaneously in these same widely separated areas and continued to be most prevalent there during the remainder of the epidemic.

After a study of the terrain it became obvious that all foci of encephalitis were situated within a mile and all except one within a half mile of the small streams in St. Louis and St. Louis County. The streams all or nearly all carry sewage. The encephalitis shading ended sharply in West End district, where the River des Peres is buried, and began sharply in the Oakland district where the same stream rises to the surface again. The survey revealed a fairly close correlation between the occurrence of epidemic encephalitis foci and the lack of outdoor sanitation in an area as judged by the presence of weeds, open sewage, ponds, streams, garbage and tin-can dumps. Ninety-five per cent. of the inhabited weed, open sewage, stream and pond area of St. Louis showed a significant ($P = 0.01-$) or probably significant ($P = 0.05$ to 0.01) preponderance of encephalitis and 87 per cent. of all cases occurred within a mile of such an area. Every district in the St. Louis area which was without weeds, open sewage and ponds and which was separated a mile or more from such an area was not only without encephalitis foci but actually showed a statistically significant scarcity of encephalitis. About 40 per cent. of the population of St. Louis lived under these fortunate conditions. In this connection St. Louis City had for the two epidemics a combined rate of 109 cases per 100,000 population, incorporated communities in St. Louis County the rate of 216, and unincorporated communities a rate of 420 per 100,000 persons.

The prevalence of encephalitis in sewage, stream, pond and weed areas could not be explained on the presence of more old people in such regions, since the mortality sample used as a control was largely made up of old persons and had the same age distribution as the encephalitis cases. Nor could poverty and poor indoor sanitation explain the prevalence in sewage, stream, pond and weed areas, since the areas in St. Louis with greatest poverty and most unsatisfactory indoor sanitation had among the least encephalitis in the St. Louis area. On the other hand, encephalitis foci did occur in districts where the population was either wealthy or above the average in wealth. The disease did not tend to predominate in the most congested areas and in general actually predominated in the most sparsely settled areas of city and county. The disease has no epidemiological feature in common with known contagious diseases (such as congested housing, prevalence in cold season, multiple cases in the same family or household, etc.) and every known feature of its epidemiology is common to the mosquito-borne diseases, such as yellow fever,[4] malaria[5] and equine encephalomyelitis.[6, 7] It shows "a lack of obvious connection between the cases as to contagion, water supply, food supply, or milk supply." In 1933 and in 1937 the disease seemed to appear simultaneously in widely separated areas in St. Louis County and City. The same areas were involved in the two years. Throughout both epidemics the predominance of the cases was in those areas in which it first appeared. It does not occur every year, occurs only in the period of the year between July and October and ends with cold weather. The disease is concentrated in the vicinity of the small streams in St. Louis and St. Louis County in areas characterized by proximity to weeds, refuse dumps, open sewage and ponds.

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[1] From the Departments of Pathology and Medicine, Saint Louis University. The work was supported by a grant from the Encephalitis Fund.

[2] J. P. Leake and others, *Public Health Bulletin*, No. 214, 1935.

[3] R. A. Fisher, "Statistical Methods for Research Workers," Oliver and Boyd, London, 1932.

A. E. CASEY
G. O. BROUN

LIFE-CYCLE OF A SPOROZOAN PARASITE OF THE OYSTER[1]

SINCE 1930 serious oyster mortalities have occurred in five different coastal regions from Mobjack Bay, Va., to Lake Barre and vicinity in Louisiana. In each instance the oysters have shown an unusually weak condition of the adductor muscle and inability to maintain closure of the shell during dredging, transplanting and shipping operations. Though the exact cause of these epidemics has not been definitely established the microscopical examination of weak and dying specimens from each region has disclosed a heavy concentration of spores in the tissues of the muscle, gills and mantle, the number per oyster frequently amounting to several million. These resistant, thick-walled spores, ovoidal in form, are generally grouped in variable numbers (1 to 16) in hypertrophied host cells and surrounded by a crescent-shaped epispore. The mature spore (length 20 µ, diameter 11 µ) contains a single vermiform sporozoite folded twice on itself and is the resting or final developmental stage in the oyster.

Studies conducted under natural and laboratory conditions show that the meats of dying, infected oysters are readily devoured by the common mud crabs, *Panopeus herbsti* and *Eurypanopeus depressus*, in the intestine of which hatching of the spores takes place. The sporozoite escapes through a micropyle and migrates to the epithelium of the gut, where it becomes attached by a globular epimerite. In 15 to 20 hours it develops into a very small, delicate, cephaline gregarine which soon detaches and undergoes precocious coupling with other sporonts (primary sporadins), forming syzygies of 2 to 10 individuals in chain-like formation. The chains break up and the young gregarines, after another short period of attachment, develop into short, cylindrical sporonts (hypersporadins) having a length of 18 to 30 µ. The characteristic gregarine stage in the crab has a granular, spherical protomerite with a lens-shaped, epimeric cap of hyalin material. The long deutomerite, rounded at the end, has a more dense, granular cytoplasm containing a large vesicular nucleus with single nucleolus. A clear, well-defined cuticle surrounds both parts and forms a wedge-shaped "muscular collar" or septum at the point of junction.

The sporonts grow to a considerable size and form syzygies of two individuals of unequal length in which the primites attain a length ranging from 275 to 342 µ and the satellites from 220 to 286 µ. These migrate to the rectum of the crab, and after becoming attached to the cuticle by an adhesive disc, coil up and form strong, thin-walled gametocysts, varying in diameter from 81 to 192 µ. The two gregarines in each gametocyst undergo extreme nuclear division into gametes which, after a period of mixing, fuse in pairs forming zygotes that become arranged radially in small groups around slightly larger central cells. These rosettes of zygotes, or gymnospores, 4 µ in diameter, are released into the water with the rupture of the gametocysts and are carried into the shell of the oyster by the feeding current. The possibilities of heavy oyster infections are great considering the general abundance of the crabs and their close association with the mollusc, and the fact that 40 to 86 gametocysts, containing from approximately 8,000 to 90,000 gymnospores each, may be produced in a single crustacean host.

Experiments with vitally stained gymnospores show that they attach to and penetrate the epithelium of the oyster gill by means of a pseudopod projected from the central cell. Though the zygotes may develop here to maturity they generally are picked up by the phagocytes and transported in the circulatory system to nearly all parts of the body. In the blood vessels and sinuses of the gills, mantle and muscle the infected phagocytes accumulate in large numbers and increase to a considerable size (diam. 30 to 100 µ) with the rapid growth of the zygotes and their transformation into sporozoites. After each sporozoite has surrounded itself with a heavy, double-walled sporocyst, the parasite has reached the characteristic resting or dissemination stage commonly found in *Ostrea virginica*. The spores were also found in the following pelecypods: *Pecten*, *Anomia*, *Ostrea equestris*, *Modiolus*, *Venus ziczac* and *Martesia* and in the gastropod, *Urosalpinx*.

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[4] Walter Reed and others, "Yellow Fever, A Compilation of Various Publications," Government Printing Office, Washington, 1911.

[5] Sir Ronald Ross, "The Prevention of Malaria," John Murray, London, 1911.

[6] C. Ten Broeck, F. W. Hurst and E. Traub, *Jour. Exp. Med.*, 62: 677, 1935.

[7] M. H. Merrill and C. Ten Broeck, *Jour. Exp. Med.*, 62: 687, 1935.

[1] Published by permission of the U. S. Commissioner of Fisheries.

The life history and morphology of this sporozoan parasite resembles that of the *Porosporidae* described on the French coast by Leger and Duboscq[2] and Pierre Hatt.[3] It is a heterogenetic gregarine with alternation of hosts, having the vegetative and reproductive phase in the intestine of decapod crustacea and sporogony in molluscs, particularly in lamellibranchs. The resistant, monozoic spores found in *Ostrea* are similar to those first described as *Nematopsis* by Schneider[4] in 1892. The American form, which will be described in detail in a forthcoming paper, is a new species for which the name *Nematopsis ostrearum* is proposed.

Studies of the effect of the parasite on adult oysters were conducted in the laboratory, where heavy infections could be produced by keeping them in close association with mud crabs carrying gametocysts or by the introduction of ripe gymnospores. In bulk experiments with several hundred oysters, losses of 66 to 73 per cent. were obtained over a period of 3 months. Kymograph records of shell movement of 35 heavily infected oysters showed abnormal and frequent contractions of the adductor muscle followed by loss of holding power and death of the molluscs. Retraction of the mantle, cessation of shell growth and weak attachment of the muscle to the shell are also characteristic of mortalities in the field and laboratory. The injury to the oyster host may be due to a toxin given off by the developing sporozoites, particularly in the sensitive mantle tissue, or to actual physical obstruction of the circulation by the masses of enlarged, infected phagocytes found in the blood vessels of the gills and muscle.

Practical prevention of the infection of oysters by this parasite is possible by control of the primary host, the mud crabs, and by exercising care in the selection of uninfected seed oysters for restocking growing and maturing areas. The crabs do not migrate and can be easily removed, before the beds are planted, by the use of dredges or scrapes equipped with fine mesh bags. In certain regions where valuable oyster beds have been abandoned or their productivity seriously reduced because of damage by this microscopic pest it should be possible to reestablish and increase production by the procedure suggested above.

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FIELD TRIPS FOR THE TEACHING OF GEOLOGY

FIELD experiences of some kind have long played a part in courses in geology. These experiences vary greatly in amount of time spent, in methods and in results obtained. Since this is the case, it is well to evaluate from time to time such geological experiences in terms of their educational possibilities.

In the endeavor to make his own field class trips most productive for his students, the writer, during a period of years, has made a study of field class procedure. As a result of this study certain conclusions have been reached and are briefly presented here.

Since much of the procedure depends upon the aims or objectives of the field trips, a concise statement of attainable and worth-while objectives is desirable. Objectives for a course in general geology to which carefully planned field trips may contribute are the following:

(1) A genuine interest in the science of geology.
(2) Some ability to correctly interpret certain geological phenomena.
(3) Some appreciation of the geological environment of mankind.
(4) The contribution of earth materials and the substances derived therefrom to man's progress, his pleasure and his comfort.

While each trip will have a part to play in the attainment of these more general objectives, it will also have some specific aim of its own. For example, the major emphasis on one trip may be devoted to only a part of Objective No. 2, yet the trip as a whole will further the realization of Objectives 1, 3 and 4.

The methods employed in the classroom, the laboratory and on the field trips should all contribute to the attainment of the objectives set up for the course. How then shall the field trip be conducted so as to bring about the greatest possible realization of these objectives?

According to the writer's experience the field trip that is to contribute as much as possible to the attainment of the foregoing objectives and which is arranged with them in mind will be such as will require a maximum of participation, interest and industry on the part of each student. Active student participation may be secured most naturally through the use of a carefully planned activity program and selected problems. The use of such a program on a field trip is challenging and highly instructive as well as interesting to students. It directs the attention of each student to the materials for study and gives him an opportunity to independently observe for typical characteristics, to note similarities and differences and to be ready to suggest explanations or interpretations for what he has seen.

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[2] L. Leger and O. Duboscq, *Trav. Stat. de Wimereux*, T. 9: 126–139, 1925.
[3] P. Hatt, *Arch. Zool. Exp.*, T. 72, 341–415, 1931.
[4] A. Schneider, *Tabl. Zool.*, T. 2: 1892.

After sufficient time has been allowed for the students to make independent observations they are called together and the observations on the assigned area summarized. On the first field trips some individuals will not only have more to report than others, but their findings will be more correct because of the wide range in the natural ability of students to observe critically.

The class is next asked to justify the summarized observations by the geological evidence at hand and by the previous study in the course. Such a procedure provides a discussion in which the students are the active participants, while the instructor serves to keep the subject open until all the evidence is weighed and conclusions reached.

If the previous experience of the class and the evidence at hand are sufficient to justify sound conclusions the problem may be followed through to a complete solution at this time.

If, however, an adequate solution of some of the field problems lies beyond the present state of the students' learning, such problems may well be left open for the present, to be taken up later in the classroom or in the field, when the course work has progressed to the required stage.

One incompletely solved problem may lead to other related ones. It may be used to stimulate student interest in these problems and to challenge their ability to solve them.

The procedure in each case will be such that the instructor serves to direct the students' attention to the problem for study, to stimulate more accurate observation and to see that the discussion comes to sound conclusions. This process of solving a problem is a cooperative venture wherein the observations of all are pooled and evaluated. The thinking of the students is sharpened and their faculties for critical observation and judgment are developed. The field trip becomes a period of discovery for the group as a whole and of development for the individual.

As students are thus given an opportunity to share in the responsibility of solving field problems the trip becomes increasingly purposeful to them and there is marked advance in the attainment of the desired objectives set up for this part of the geological program.

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AGRONOMIC SCIENCE, 1838–1938

Along with other scientific contributions of which 1938 marks the centenary, agronomists should not let pass unnoticed those of the Frenchman Boussingault. Just a century has passed since Jean Baptiste Boussingault, adventurer, traveler, chemist and "farmer of Bechelbronn," made his first fundamental contribution toward the solution of the problem of nitrogen assimilation by plants. In two papers published in 1838 in volumes 47 and 49 of *Annales de Chimie et de Physique* he reported results of carefully conducted experiments which showed that certain legumes grown in sterile soil "acquired a very appreciable quantity of nitrogen" and that "wheat and oats (non-legumes) grown in the same circumstances . . . showed no increase in nitrogen after their maturity." A little later Boussingault conducted field experiments with crop rotations, some of which contained legumes. The harvested crops were carefully weighed and analyzed. Boussingault stated, "it was with the purpose of substituting positive facts for mere guesses" that he undertook the work. His experiments virtually mark the beginning of agronomic science.

A. B. Beaumont

REPORTS

THE DEPARTMENT OF AGRICULTURE APPROPRIATION ACT, 1939[1]

Appropriations made in the act for the support of the Federal Department of Agriculture for the fiscal year ending June 30, 1939, as signed by President Franklin D. Roosevelt on June 16, 1938, aggregated $742,040,279, plus $187,105,000 of reappropriated funds. If to this are added $152,023,958 for the so-called "permanent" appropriations, which automatically become available, $825,000 carried in the Second Deficiency Act, $7,000,000 transferred from the War Department for flood control surveys and $387,000,000 available under the Work Relief and Public Works Appropriation Act of 1938, the total for the year becomes $1,475,994,237. The comparable aggregate for the preceding year, including deficiency appropriations, was $984,005,456, of which $850,794,177 was derived from the appropriation act.

By far the largest allotment is that for the conservation and use of agricultural land resources. The act itself appropriates $345,000,000 and reappropriates $155,000,000, while $356,024,893 additional will be available from other sources for parity payments to producers of wheat, corn, cotton, rice and tobacco and for other price adjustments. Second in size only to these appropriations are the grants for roads. The Bureau of Public Roads receives $187,500,000, an increase of $20,000,000, mainly for more rapid elimination of grade crossings and the construction of federal-aid feeder roads, and in addition $14,000,000, an increase from $12,500,000, is made available for forest roads and trails. A third major allotment is that of $175,000,000 to the Farm Security Administration for loans, relief and rural rehabilitation.

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[1] From the *Experiment Station Record*.

Other large items relate to the carrying into effect of recent legislation, such as the Sugar Act of 1937, for which $48,000,000 is provided, and the Farm Tenant Act, with $25,000,000 for loans to farm tenants, $2,000,000 for the liquidation and management of resettlement projects and $5,000,000 for land utilization and the retirement of submarginal land. A reappropriation of $25,500,000 is made under the Federal Crop Insurance Act of 1938; $1,800,000 is granted for the retirement of cotton pool participation trust certificates; and $500,000 is allocated to develop facilities for water storage and utilization.

The special research fund of the department under the Bankhead-Jones Act (E. S. R., 73, p. 289) is increased from $1,200,000 to $1,400,000. Authorization is also given to utilize not to exceed $100,000 of funds available under the Agricultural Adjustment Act of 1938 to conduct a survey to determine the location of the regional research laboratories provided under that act (E. S. R., 78, p. 437) and the scope of the investigations to be made, and to coordinate the research work now being carried on.

For what are termed the "ordinary activities" of the department the allotment is $93,747,611, a decrease from $99,314,204. The largest item under this heading is that for the Soil Conservation Service, which shows an apparent decrease from $24,390,780 to $23,525,000. Of this amount $425,135 represents transfers to other bureaus of the department, and the remainder is a curtailment for operations, demonstrations and information. The allotment for soil and moisture conservation and land-use investigations is $1,510,601.

A total of $19,560,400 is provided for the Forest Service. Its net increase of $668,218 is largely in the funds for administration of the national forests and for increased cooperation in forest fire control, farm forestry and private forestry.

An apparent increase from $10,373,098 to $14,136,731 for the Bureau of Animal Industry is more than offset by a reduction from $15,864,000 to $6,600,000 in the funds reappropriated for the campaign against tuberculosis and Bang's disease, making the new total for this purpose $12,003,000. The remaining allotments of the bureau are continued without substantial change.

The funds administered by the Extension Service are increased from $17,490,083 to $17,917,583. The full authorized increase of $1,000,000 in Bankhead-Jones funds is provided, but $645,000 has again been deducted from certain supplementary funds hitherto available under a sliding-scale arrangement looking toward their complete replacement by Bankhead-Jones funds in 1940. An increase of $3,000 is made for extension work in Alaska, raising the total to $21,418, while $45,000 is allotted to extend the Bankhead-Jones Act to Puerto Rico.

Under the Office of Experiment Stations a total of $6,770,230 is provided, of which $6,541,250 represents payments to the States, Hawaii, Alaska and Puerto Rico for agricultural experiment stations, including $720,000 each under the Hatch and Adams Acts, $2,880,000 under the Purnell Act, $2,100,000 under the Bankhead-Jones Act, and a total of $121,250 under supplementary legislation (of which Hawaii receives $55,000, Alaska $23,750 and Puerto Rico $42,500). This is an increase of $308,750 over the previous year, of which $300,000 is under the Bankhead-Jones appropriations. For the administrative expenses of the office itself, $161,735 will again be available, while the supplementary administrative allotment of 2 per cent. of the special research fund of the department under the Bankhead-Jones Act automatically increases from $24,000 to $28,000. In addition $67,245 will be available for the maintenance of the Federal Experiment Station in Puerto Rico, but in Hawaii participation by the office in the management of the station maintained in recent years jointly with the University of Hawaii is terminated as planned as of July 1, 1938.

The allotments for the Bureau of Agricultural Economics show a total of $6,566,483 and a net increase of $353,785. The items of increase include $225,483 to carry into effect the provisions of an act approved on April 13, 1937, for classification and information service in communities organized for cotton quality improvement; $90,000 and $65,000, respectively, to strengthen the enforcement of the Tobacco Inspection and Warehouse Acts; $45,302 to extend the market news service; and $23,500 for additional market inspection of farm products. Offsetting them in part are decreases of $30,000 for studies of farm management and practice, $35,000 for studies in marketing and distributing farm products, $15,000 for crop and live-stock estimates, $3,000 for studies of foreign competition and demand, and $10,000 under the Cotton Futures and Standards Act.

The funds provided for the Bureau of Entomology and Plant Quarantine are decreased from $5,711,398 to $5,701,867, but $700,000 additional is made available in the Second Deficiency Act for the control of grasshoppers and other pests and $10,000 for the use of the Mediterranean Fruit Fly Board. Increases are made in the allotments from $296,800 to $446,800 for Thurberia weevil control, from $381,580 to $461,580 for truck crop and garden insects in order to construct a tobacco laboratory at Oxford, N. C., and from $182,600 to $191,000 for insects affecting man and animals. The decreases are distributed among seven projects, the largest being the control of screw-worms, Japanese beetles and gipsy and browntail moths, the insecticide and fungicide investigations and the insect pest survey.

The total for the Bureau of Plant Industry shows a decrease from $4,909,048 to $4,741,675, distributed among 12 items, the largest reductions being $106,200 for sugar plant investigations, $67,413 for the National Arboretum and $64,750 for the studies of dry-land agriculture. These are offset in part by an increase of $119,700 for studies with fruit and vegetable crops, particularly tung-oil investigations. The latter will be supplemented by chemical studies under an allotment of $30,000 to the Bureau of Chemistry and Soils. This bureau is also given an increase of $39,957 for work in the industrial utilization of farm products and byproducts, especially sweetpotato drying and citrus byproducts. Despite slight reductions on its other projects, the total for the Bureau of Chemistry and Soils rises from $1,425,431 to $1,457,508.

The Bureau of Biological Survey is granted an allotment of $1,000,000 under a 1937 act for federal aid to the states in wildlife restoration projects, as well as $25,000 additional for the development of fur resources investigations. Its total appropriation is increased from $2,127,840 to $3,248,340.

The remaining work of the department is provided for much as at present. The Weather Bureau receives $4,987,870, a net increase of $284,821, available entirely for additional aerological work; the Bureau of Dairy Industry $717,405, an increase of $13,711 for investigations; the Bureau of Home Economics $305,085, an increase of $60,000 to be divided equally between investigations of family economics and cotton hosiery; the Commodity Exchange Administration $635,000, an increase of $135,000; and the Bureau of Agricultural Engineering $510,000, an increase of $49,231. An apparent increase of $220,640 to the Office of Information raises its total to $1,474,770, but it is made up entirely of transfers from the Soil Conservation Service and provides no additional funds. The Food and Drug Administration again receives $2,227,758, the Library $105,420, and the Beltsville Research Center $85,000 (an increase of $10,000).

SPECIAL ARTICLES

RECOVERY OF THE VIRUS OF EQUINE ENCEPHALOMYELITIS FROM THE BRAIN OF A CHILD

ON August 31, 1938, brain material from a twenty-months-old boy was received through the courtesy of Dr. H. M. Ginsburg, Dr. Newell and Dr. S. Simon, of the Fresno County General Hospital, Fresno, California. The child was admitted to the hospital on August 27 after a two-day illness. He became progressively worse, developed muscle spasms, became comatose and died on August 30, or 5 days after the initial onset, with the diagnosis of acute encephalitis.

A portion of the brain stem was ground in Ringer's solution to make a 10 per cent. suspension and was injected intracerebrally, intraperitoneally and intranasally into young Swiss mice. Most of them died in 3 to 5 days, while the others were sacrificed upon showing neurological symptoms; tremor, initial excitability followed by drowsiness and later complete prostration. The brains were removed and were found to be free from bacteria. A 10 per cent. suspension was inoculated into normal mice, who succumbed with similar symptoms. Berkefeld N filtrates were also infectious for mice, and it was found that the active agent could be carried in serial passage in these animals.

Mouse brain suspensions were then inoculated intracerebrally into monkeys, guinea pigs, young rabbits and rats. All developed typical encephalitic symptoms of fever, tremor, twitchings of the extremities, drowsiness, spastic convulsions in the case of the monkeys, and became completely prostrate in 4 to 5 days. Spinal fluid of a monkey removed at the height of the temperature, 40.7° C, contained the virus upon inoculation of mice. Brain material from this monkey was infectious upon removal post mortem. The disease could be transmitted by the intranasal and the subcutaneous routes of inoculation in both mice and guinea pigs.

From the incubation period of 4 to 5 days, from the general clinical picture, especially in the guinea pig and from the fact that the virus could be transmitted to such a variety of animals by various routes of inoculation, the virus of equine encephalomyelitis, western type, was suspected. Further confirmation was obtained by neutralization, complement fixation and cross-immunity tests. Using methods previously described,[1] it was found that this new (Br) virus neutralized hyperimmune serums of the western type of equine encephalomyelitis but not those of the eastern nor the Moscow No. 2, nor was there any neutralization with immune serums of the viruses of lymphocytic choriomeningitis, the Japanese B nor the St. Louis types of human encephalitis, respectively. Guinea pigs immune to the western variety were unaffected by an intracerebral inoculation of the new strain, while two monkeys immune to poliomyelitis succumbed to the disease in 4 days. Guinea pigs immune to the virus of lymphocytic choriomeningitis and mice immune to the St. Louis strain were all susceptible to intracerebral injection of the Br virus.

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[1] B. F. Howitt, *Jour. Immunol.*, 33: 235, 1937.

Mouse brain antigens, prepared with this virus by methods previously described,[1] gave a positive complement fixation against immune serums of the western type but not against those of the eastern or the Moscow No. 2 equine strains nor of lymphocytic choriomeningitis.

During the summer months of both 1937 and 1938 numerous cases of encephalitis of unknown etiology have been reported from the San Joaquin Valley regions in California; especially from around Fresno and Tulare. Until the present time no virus had been recovered from the few specimens examined, but it had been shown[2] that serums from 56.6 per cent. of the recovered cases in this area gave neutralizing antibodies to the virus of St. Louis encephalitis. Although no virus was found, it was assumed that this strain was present in the locality. However, the clinicians were recognizing several different clinical pictures in their patients; an extremely acute, fulminating form with death in a few days, a lethargic type with a prolonged course usually with residual effects, and others that were milder, sometimes transient, ending in good recovery. Cases were reported in all age groups, with many in children and babies. Definite convulsions were often noted in the young children, persisting for some time. Serums from this latter group and from those having residual after-effects were usually negative when tested for neutralization against the St. Louis virus. At present, serums from three children having the convulsive type at the Kern County Hospital have been found to neutralize the new Br strain of virus and not that of the St. Louis. It seems probable, therefore, that both these viruses are responsible for cases of encephalitis in these regions.

Although the virus of equine encephalomyelitis was first reported by Meyer, Haring and Howitt[3] from the horses in the San Joaquin Valley area in 1931, yet this is now the first time the virus has been recovered from a human brain in California. However, that it very likely could be transmitted to the human host from the equine was early considered by Meyer,[4] who in 1932 reported one fatal and one non-fatal case of suspected encephalomyelitis in two men associated with sick horses. The symptoms were similar to those shown by many of the present cases. That the virus could be recovered from a human being had also been noted by the writer in 1934 when it was found in the cerebrospinal fluid of a man who died under such unusual conditions that the case could not be reported at the time.

Although the equine disease has been endemic among the horses in the valley regions for a long period, yet there have been no unusual number of cases reported among the animals during the past few years.

It is interesting that the virus of equine encephalomyelitis should have been found in man almost coincidently in two widely separated portions of the United States, being first reported recently from Massachusetts by Fothergill, Dingle, Farber and Connerly[5] and by Webster and Wright[6] for the eastern type and now in California for the western form, which is serologically and immunologically distinct from the other.[7]

BEATRICE HOWITT

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SIZE AND STROKE OF THE HEART IN YOUNG MEN IN RELATION TO ATHLETIC ACTIVITY[1]

THERE is a common belief that strenuous athletic activity results in an increased size of the heart. It is also frequently considered that this may be a deleterious adaptation, either because it indicates undue strain or because of the danger of eventual degeneration. The scientific debate on this question is now more than thirty years old,[2] but there are important inconsistencies in the published data. Papers up to 1933 were reviewed by Steinhaus.[3] In a more recent paper Roesler[4] states that the diastolic outline was unusually large in four athletes and that the outline was decreased after cessation of training.

Our comment on previous work may be summarized briefly: (1) Most of the studies have been made with the orthodiagraph, so that the heart shadow is only outlined in diastole. (2) True resting conditions have not always been maintained. (3) When the teleroentgenographic method was used precise correction for distortion was not made from lateral roentgenograms on the different individuals. (4) Strictly comparable controls were not measured under the same conditions.

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[2] B. F. Howitt, *Jour. Bacter.*, 36: 294, 1938.

[3] K. F. Meyer, C. M. Haring and B. F. Howitt, SCIENCE, 44: 227, 1931.

[4] K. F. Meyer, *Ann. Int. Med.*, 6: 645, 1932.

[5] L. D. Fothergill, J. H. Dingle, S. Farber and M. L. Connerly, *New England Jour. Med.*, 219: 411, 1938.

[6] L. T. Webster and F. H. Wright, SCIENCE, 88: 305, 1938.

[7] Appreciation is extended to Dr. H. M. Ginsburg, Dr. F. Cooley, Dr. Newell and Dr. S. Simon, of the Fresno County General Hospital, and to Dr. M. A. Gifford and Dr. W. C. Buss, of the Kern County Hospital, for their kind cooperation and many courtesies offered.

[1] From the Laboratory of Physical Education and Physiology and the Department of Radiology, University of Minnesota Medical School, Minneapolis, Minnesota.

[2] Schieffer, *Deut. Arch. klin. Med.*, 89: 604, 1907.

[3] A. H. Steinhaus, *Physiol. Rev.*, 13: 103–147, 1933.

[4] H. Roesler, *Am. Jour. Roentgenology*, 35: 849–858, 1936.

(5) It is uncertain that the effect of body size was corrected for properly.

In this laboratory we have studied college students between the ages of 18 and 28. All measurements have been made in the afternoons of days on which the subjects had not had any strenuous exercise. The subjects had had light luncheons from 3 to 4 hours previously, except in a few cases where the interval after luncheon was slightly less. In the laboratory each subject rested quietly in bed for 15 to 30 minutes and was then wheeled into the x-ray room on a litter. After receiving instructions, the subject stood up and a Roentgen kymogram was taken immediately. Effort was made to secure the same degree of inflation of the lungs in all subjects. The x-ray tube was kept at 66 inches and the period of exposure was either 2.5 or 3 seconds. The slits in the lead kymograph grid were 1 mm in width and the distance between slits was 10 mm. Immediately following the Roentgen kymogram, an ordinary lateral plate was made from 6 feet.

The outlines of the diastolic and systolic shadows were traced in pencil directly on the x-ray negative; in the small uncertain region of the upper and lower margins the diastolic and systolic outlines were made to coincide.[5] The outlines were transferred to tracing paper for measurement of the areas by the planimeter. The area measurements were made in triplicate. Body surface was calculated from the formula of DuBois.[6]

On the basis of complete records of college, high school and outside muscular activities, the subjects were graded into three groups with the following general characteristics: (1) *Athletes*—highly successful competitors in several major sports involving severe and prolonged exertion (football, basketball, rowing, distance swimming and running). (2) *Non-Athletes*—those who indulged in no more than occasional mild athletic recreation. (3) *Intermediates*—moderately successful competitors in one major sport, such as football, or several sports, such as baseball, tumbling, field events, etc.

The relative sizes of the hearts in systole are shown for the three groups in Fig. 1. In terms of square centimeters of heart shadow per square meter of total body surface, there is no significant difference between the three groups.

A very different result emerges when we compare the relative stroke areas (diastolic area minus systolic area, per square meter of total body surface). There is a regular progression from large to small—athletes, intermediates, non-athletes—in both the means and the ranges, and these differences are significant.

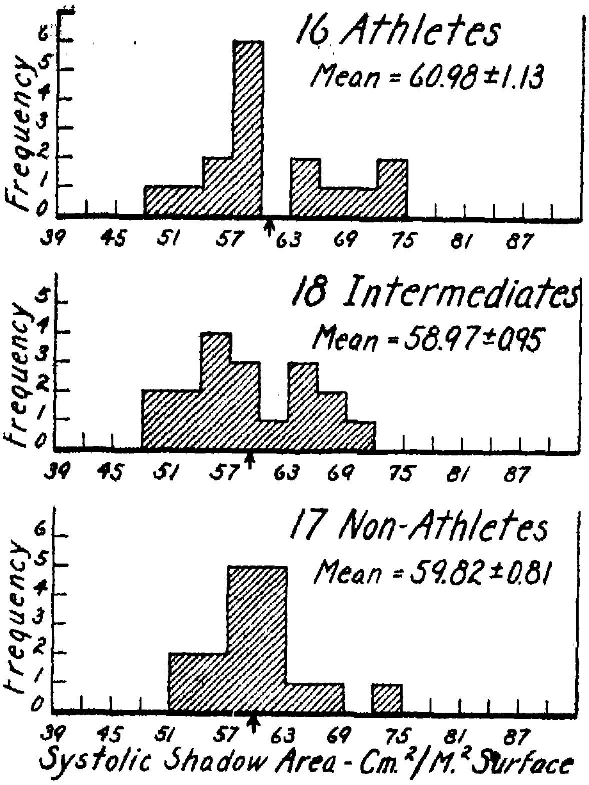

FIG. 1. Size of the posterior anterior projection of the systolic heart in rest. Means, probable errors and numbers of individuals in groups separated by intervals of 3 square cm per square meter of body surface.

The number of individuals compared here is somewhat small, but several tentative conclusions seem justified: (1) Continued successful participation in strenuous sports through the college years does not lead to any significant increase in the size of the contracted heart in rest. If we may assume, as seems reasonable, that there is no great difference in the degree of emptying of the ventricles at contraction, this would mean that the relative muscle mass of the heart is also practically unaffected. In this connection it should be noted that, as we have drawn the outlines of the Roentgen-kymograms, the ventricles represent nearly the entire measured shadow.

(2) The degree of relaxation and filling of the heart in diastole is very much greater in the athletes than in the non-athletes, the moderate athletes being intermediate but closer to the non-athletes.

The main requirement for the blood circulation provided by the heart is the transport of the gases involved in metabolism. Under resting conditions the metabolism is normally most closely related to the total body surface. For this reason we have expressed heart size in terms of body surface in order to correct for the effect of the varying sizes of the individuals. However, the same relations as reported above are found when comparisons are made of heart size per

---

[5] C. R. Bardeen, *Am. Jour. Anat.*, 23: 423–487, 1918.

[6] E. F. DuBois, "Basal Metabolism in Health and Disease," Philadelphia, Lea and Febiger, 1936.

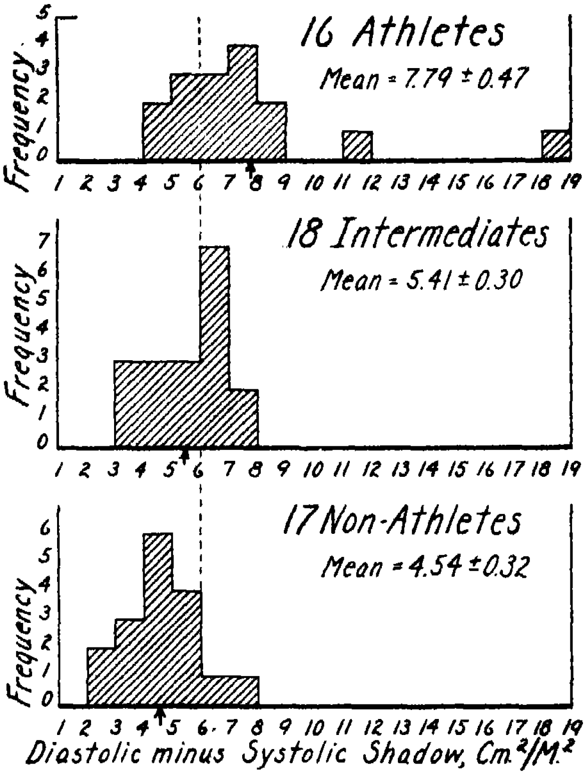

FIG. 2. Size of the stroke of the heart in posterior-anterior projection. Means, probable errors and numbers of individuals in groups separated by intervals of 1 square cm per square meter of body surface.

unit of body weight. We found, however, that the variation between individuals was 12 per cent. greater when body size alone was used.

In our series bradycardia was well marked in the athletes, and the slowness of pulse was, on the whole, proportional to the extent of participation in strenuous sports. It would be tempting to estimate rates of circulation from these data, but special experimental studies are needed to provide the numerical factors and to evaluate the accuracy of such a procedure. These experiments, on which we are now engaged, include:

(1) *Simultaneous Roentgen kymography and direct cardiac output studies on the heart-lung preparation of the dog.*

(2) Simultaneous Roentgen kymography and cardiac output measurement by the acetylene method in man.

(3) Roentgenograms on the heart in the intact cadaver followed by direct measurements on the heart removed from the chest.

(4) Calculations from mean cardiac outputs and mean cardiac shadows in normals.

The results thus far indicate that the estimation of cardiac output and total heart volume is perfectly feasible from the Roentgen kymograms. Since completion of this note we have partially completed an analysis on a larger series of subjects with the results in full agreement with those given here.

ANCEL KEYS
H. L. FRIEDELL

TOBACCO-MOSAIC VIRUS CONCENTRATED IN THE CYTOPLASM[1]

INVESTIGATIONS carried out by Chibnall[2, 3] and by Phillis and Mason[4] indicate that the vacuolar sap and the cytoplasmic extract can be obtained as essentially separate fractions when the leaves are subjected to suitable treatments. Phillis and Mason separated the vacuolar sap from the cytoplasm of cotton leaves by simple application of 6,000 to 16,000 pounds per square inch pressure to the whole leaves. It was found that this method is unsuitable for tobacco leaves, the texture of the leaf being destroyed at pressures much less than those to which cotton leaves were subjected. We were successful in using the method of Chibnall,[2] which was also used by Livingston and Duggar[5] in similar studies.

Fresh leaves were harvested from mature *Nicotiana tabacum* L., variety Maryland Medium, systemically infected with tobacco common mosaic. Midribs were removed, and 175 grams of leaf tissue completely immersed in 100 grams of ether for 10 minutes. Surplus ether was poured off and the leaves placed flat in a pile of cheese cloth, between flat plates of a hydraulic press. Pressure was applied slowly, up to 5,000 pounds per square inch, and the vacuolar sap obtained as a clear brown liquid, amounting to 45 cc. The pressed tissue was frozen over night at zero degrees F. and thoroughly pulped in a meat grinder. The ground pulp was diluted with 50 cc of water and 20 cc of 0.5 M disodium phosphate solution added. After extracting at two to four degrees C. over night the whole juice was pressed out. This extract was dark green and contained much pigment and cell debris. After filtering through Celite, 78 cc of clear brown solution was obtained, which was regarded as cytoplasm sap.

In agreement with the results of Chibnall[2] on spinach, the vacuole sap contained a very small amount of protein. It was partially insoluble in 0.5 saturated ammonium sulfate and precipitated by trichloro-acetic acid. The 45 cc of vacuolar sap contained 0.317 mg/cc of total N, and only 0.022 mg/cc of protein N. Most of the protein was in the 78 cc of cytoplasmic extract, which contained 0.583 mg/cc of total N, and 0.389 mg/cc of protein N. On this basis the vacuolar sap contained 0.13 mg/cc of protein, and the cytoplasmic extract contained 2.36 mg/cc of protein.

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[1] Studies conducted under Bankhead-Jones Project S.R.F. 2-17, U. S. Department of Agriculture, Bureaus of Plant Industry and Chemistry and Soils cooperating. Food Research Division Contribution No. 387.

[2] A. C. Chibnall, *Jour. Biol. Chem.*, 55: 333, 1923.

[3] *Ibid.*, *Jour. Biol. Chem.*, 61: 303, 1924.

[4] E. Phillis and T. G. Mason, *Nature* (London) 140: 370, 1937, No. 3539.

[5] L. G. Livingston and B. M. Duggar, *Biol. Bull.*, 67: 504, 1934.

The vacuolar sap, the cytoplasmic extract and a control preparation of highly purified virus protein were each diluted to a uniform protein content of 10^{-4} mg of protein/ml in a phosphate buffer at pH 7. Each diluted sample was assayed on the primary leaves of *Phaseolus vulgaris* Var. Scotia. The vacuolar sap, the cytoplasmic extract and the control induced 1; 240; and 222 necrotic lesions respectively on 32 leaves each.

The results of this assay indicate that the protein in the vacuolar sap is chiefly a non-infectious form, and it seems likely that part or possibly all of the trace of virus in this fraction represents contamination from the cytoplasm during the pressing process.

The paracrystalline control virus has been tested many times, and there is reason to believe that its activity in this test represents very nearly the maximum for purified preparations on an equivalent protein basis. The virus activities of the cytoplasmic fraction and the control are so close it is believed that a very large part of the protein extracted in the cytoplasmic fraction is virus protein. An investigation of the total protein in tobacco leaves[6] warrants the assumption that the protein extracted in this fraction is probably less than half of the total protein in the leaf.

Livingston and Duggar,[5] working with tobacco mosaics, obtained cytoplasmic extract and vacuolar sap by means of Chibnall's method and also by means of micro-pipettes inserted directly into individual infected cells. The fractions were not adjusted to a uniform protein content, but when tested on tobacco the cytoplasmic fraction obtained by both methods was found to contain more virus than the vacuolar sap. Our assays were made after adjusting the extracts to equal protein concentrations, and the results indicate even more definitely the localization of virus protein in cytoplasm.

Since the virus is in the cytoplasm it would seem to be a comparatively simple matter to explain its passage from cell to cell through the plasmodesmata, as suggested by Livingston.[7] Many of these cytoplasmic strands which connect the cytoplasm of adjacent cells are visible under the microscope, when suitable methods are used, and therefore, they should be sufficiently large to allow the passage of the ultra-microscopic particles of virus. Eames and MacDaniels[8] consider that plasmodesmata are common in the living tissues of the seed plants, and Livingston's[7] studies indicate their presence in great number throughout the living tissues of the tobacco plant. Therefore, it seems likely that the plasmodesmata supplement the vascular system in the transport of virus.

The observations and experiments leading to the interpretations presented are not in agreement with ideas[9] that the walls of living cells are impervious to the virus and that the virus which is introduced as inoculum generates directly or indirectly some unknown physical force which is transmitted through the cell wall into the adjacent cells where this force initiates the synthesis of new virus.

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SCIENTIFIC APPARATUS AND LABORATORY METHODS

A TIMER FOR USE WITH A WESTINGHOUSE MOVING COIL OSCILLOGRAPH

IN using a Westinghouse four-unit moving coil oscillograph in conjunction with amplifiers for recording muscle action currents and brain potentials, some time-recording device is essential.

The methods we have seen employed have one or both of two disadvantages, the first being the necessity for use of one oscillograph element for recording the timing and the second being the limitation of the time markings to one border of the paper. Use of an oscillograph element for recording time is expensive and eliminates the element from availability for recording physiological phenomena. A time line which is limited to one border and is not projected across the entire surface of the paper is difficult and time-consuming to read.

We have devised for use on a Westinghouse four-unit oscillograph, recording on sensitized paper, a timer which does not require the use of an oscillograph unit and can be produced for substantially less money than can that type. It produces time lines which are superimposed upon the physiological records and traverse the entire width of the sensitized paper record. It is capable, with an interchange of one part, of recording time intervals of from one-half second to a fortieth of a second or less. By means of a motor geared higher or lower than the one we have used, its range can be widened considerably.

The device consists of a slotted brass cylinder mounted on bearings within a slightly larger cylinder, the ensemble being mounted on the top of the cover for the oscillograph about midway between the ends. The larger cylinder has cut in it two slots opposite each other on the upper and lower sides. Above the cylinder ensemble is mounted a small tubular light bulb. Below the cylinder in the top of the oscillograph box is cut a small transverse slit, five inches long. The small inner cylinder in which is cut anywhere from two to forty opposing slots is turned by a geared synchronous motor which revolves the cylinder at the rate of one revolution per second. Enlargement of one of these pairs of slots will provide heavier time lines at half-second intervals in addition to the regular markings at one-fourth, tenth or twentieth second intervals. Light from the bulb passes through the pairs of slots in the two cylinders whenever these slots coincide, and through the slotted box cover to a 90 degree reflecting prism or mirror where it is directed forward through the oscillograph condensing lens to a second mirror and onto the paper. Fig. 1 presents a diagrammatic sketch of the arrangement. The light used is a 25-watt, 120-volt cylindrical house bulb which may be purchased for 40 cents. The motor is a synchronous one of one-one hundred and fiftieth horse power geared to turn the drive shaft one revolution per second. It is a product of the Bodine Electric Company of Chicago. The 90 degree reflecting prism is a standard Bausch and Lomb product, while mirror number 2 is a chromo-plated first surface one produced by the Evaporated Metal Film Corporation of Ithaca, New York. A rheostat of 500 ohms permits adequate adjustment of light intensity for any sensitization of paper or film and for the different speeds at which it may be run. A sheet brass housing encases the lower portion of the cylinders and extends down through the top of the oscillograph box so as to prevent extraneous light from entering the box. The lower end of this housing serves also as the mounting for the reflecting prism. Fig. 1 shows a diagrammatic sketch of the timer and mirror arrangement, and Fig. 2 a sample of time lines at one tenth second intervals as they appear on a skin resistance, respiration and electrocardiographic record made with the apparatus. The apparatus was built by A. E. Berdon, Yellow Springs, Ohio.

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[6] L. F. Martin, A. K. Balls and H. H. McKinney, SCIENCE, 87: 2258, 329, 1938.

[7] L. G. Livingston, *Am. Jour. Bot.*, 22: 75, 1935.

[8] A. J. Eames and L. H. MacDaniels, "An Introduction to Plant Anatomy." New York, 1925.

[9] W. M. Stanley, *Phytopathology*, 26: 305, 1936.

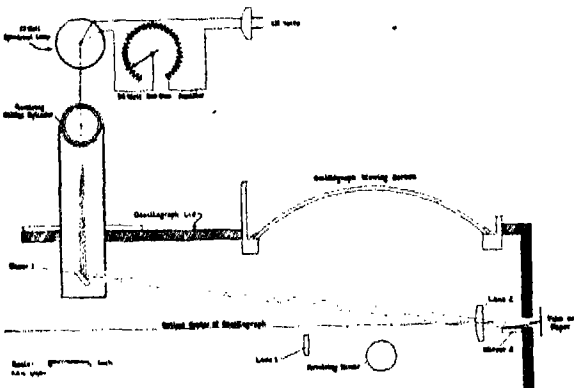
110 volts
Oscillograph Viewing Screen
Oscillograph Lid
Optical System of Oscillograph
Lens 1
Lens 2
Mirror 2
Revolving Drum
Cross-Sectional Scheme of Layout

FIG. 1.

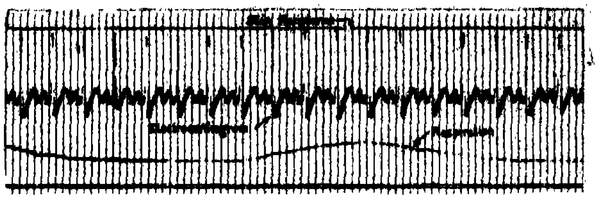

FIG. 2.

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BOOKS RECEIVED

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Anthropological Papers; Bureau of American Ethnology, Smithsonian Institution, Bulletin 119. Pp. ix + 204. 37 figures. 18 plates. Superintendent of Documents, Washington. $0.40.

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WEIDENREICH, FRANZ. *The Relation of Sinanthropus Pekinensis to Pithecanthropus, Javanthropus and Rhodesian Man.* (Reprinted from the Journal of the Royal Anthropological Institute, Vol. LXVII, 1937.) Pp. 51–65. Illustrated. The Institute. London.

WEIDENREICH, FRANZ. *The Ramification of the Middle Meningeal Artery in Fossil Hominids and Its Bearing Upon Phylogenetic Problems.* New Series D, No. 3; Palaeontologia Sinica. Pp. 16. 30 figures. National Geological Survey of China, Peiping.

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FIFTY YEARS OF AMERICAN MATHEMATICS[1]

By Professor GEORGE D. BIRKHOFF
HARVARD UNIVERSITY

IT is indeed a great honor to participate in this semi-centennial celebration of the founding of the New York Mathematical Society in 1888, which became in 1894 the American Mathematical Society. As one of the speakers I have set myself the challenging task of tracing our mathematical development under the auspices of the society during the years which have passed. Obviously in such a *coup d'oeil* only the principal factors involved can be alluded to, and the point of view adopted must necessarily be more or less personal.

At the very outset it is well to recall the general mathematical background of our country at the time when the society came into existence. In colonial days scientific and mathematical knowledge had a certain definite standing, largely for its practical value but in part also for its own sake. George Washington was a scientifically minded gentleman farmer for much of his life, and in his youth was a skilled surveyor, familiar with trigonometry; Benjamin Franklin discovered experimentally the electrical nature of the lightning discharge, theorized concerning electricity as a fluid, and had enough mathematical interest to devise ingenious magic squares; Thomas Jefferson regarded geometry and trigonometry as "most valuable to every man," algebra and logarithms as "often of value," while he classed "conic sections, curves of the higher orders, perhaps even spherical trigonometry, algebraic operations beyond the 2d dimension, and fluxions" as a "delicious luxury"; in his later years Jefferson spent much of his time in mathematical reading, and was ever a true friend of mathematics. The interest in science and mathematics continued to be genteel and amateurish among American scholars and devotees until towards the middle of the last century, with few notable exceptions. The best mathematicians of those days looked appreciatively toward Europe without much thought of high emulation.

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[1] Opening portion of an address delivered at the semi-centennial celebration of the American Mathematical Society, New York City, September, 1938.

Then came a gradual change in the temper of the times, which led to the formation of our society. Characteristic of this change were the outstanding figures of Benjamin Peirce, of Josiah Willard Gibbs and of George William Hill. Peirce died in 1880, Gibbs in 1903 and Hill in 1913, having been fourth president of the society in the years 1894 to 1896. But it was the contagious enthusiasm of a group of young Americans, returning from mathematical studies in Europe, which proved the immediate cause of the formation of our society; and in this so important enterprise Thomas Scott Fiske, seventh president of the society, and Frank Nelson Cole, long its devoted secretary, took leading parts. The year 1888 of our beginning as a professional body devoted to the interests of research marks with precision our coming to a fitting mathematical position among the nations of the earth.

Of the three figures mentioned it was Benjamin Peirce who was by far the most influential in America as a scientific personage. I remember a talk about Peirce with his last pupil, the late Dr. Leonard Waldo, mathematical meteorologist. Waldo said that the first sight of Peirce seated behind his desk at home rendered him quite speechless. Ex-President A. Lawrence Lowell, of Harvard University, fell under Peirce's mathematical spell while an undergraduate and wrote a few years ago: "Looking back over the space of fifty years since I entered Harvard College, Benjamin Peirce still impresses me as the most massive intellect with which I have ever come into close contact, and as being the most profoundly inspiring teacher that I ever had. His personal appearance, his powerful frame and his majestic head seemed in harmony with his brain."

Benjamin Peirce's papers on "Linear Associative Algebra," announced at the first meeting of the American Association for the Advancement of Science in 1864, give him a just claim to be considered an eminent mathematician. His researches in this field were made at a time when English and American mathematicians looked upon the great invention of quaternions by W. R. Hamilton as a supreme achievement, destined to be of incalculable importance for mathematics and physics. Peirce saw more deeply into the essence of quaternions than his contemporaries, and so was able to take a higher, more abstract point of view, which was algebraic rather than geometric. However, he was much more than an algebraist, for he was well informed about some of the most significant mathematical developments of his day. His volumes, "Curves, Functions, and Forces," testify to a real interest in the function-theoretic work of Cauchy, albeit somewhat superficial in character. His large book, "Analytical Mechanics," showed that he had read and mastered the works of Hamilton, Jacobi and others in the extensive field of dynamics. In addition, he was skilled in the theory and methods of computation useful for dynamical astronomy, and spent a considerable amount of time during later years in a somewhat unhappy attempt to show that Leverrier and Adams had no adequate basis for the calculations leading to the celebrated discovery of the planet Neptune; one naturally calls to mind the calculations by the eminent astronomer, the late Percival Lowell (brother of A. Lawrence Lowell), which brought about the discovery of the small planet Pluto in 1930, since these calculations have also been occasionally criticized for similar reasons.

Despite Peirce's remarkable ability to inspire especially capable and advanced students, he was not regarded as a good teacher for the rank and file; a characteristic feature of his lectures was a reaching toward seemingly endless vistas of abstract generalizations.

Josiah Willard Gibbs was a man of modest and not especially impressive personality, who did far more to advance physics and chemistry through his work on statistical mechanics and the equilibria of chemical systems than Peirce ever did for pure mathematics. Gibbs's title to be considered a mathematician rests mainly upon his largely notational contributions to vector analysis, a subject also closely related to Hamilton's quaternions. The late Maxime Bôcher, who with William Fogg Osgood really succeeded Peirce at Harvard, later attached the name of "Gibbs's phenomenon" to a fundamental fact about Fourier's series which was observed by Gibbs; this is related to the peculiar behavior of the successive curves of approximation $y = s_n(x)$ to a discontinuous function near the point of discontinuity. As has happened from time to time here and elsewhere, the fundamental contribution of Gibbs's physical work was first recognized by admirers in other countries, in particular by James Clerk Maxwell, so that it was only somewhat tardily, by reflected light as it were, that Gibbs came to be properly appreciated in the United States.

George William Hill was a scientific figure of altogether unconventional type who spent more than three decades of his life as an assistant in the Nautical Almanac office in Washington and then went back to the place of his birth, West Nyack, N. Y., to continue his researches.[2] Hill, like Gibbs, never married. His life was devoted to what were essentially mathematical studies of the solutions of the three-body problem useful to the lunar theory and in making specific astronomical computations. His work on periodic motions was the worthy forerunner and inspiration of the splendid theoretical advances of Henri Poincaré in celestial mechanics, who thus owed much to Hill's achievements. The free introduction of infinite determinants by Hill in his celebrated papers on the restricted problem of three bodies was especially noteworthy, although it is only recently that this interesting analytic instrument has been perfected.

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[2] Professor R. C. Archibald has informed me that Hill lived in Washington only for ten years.

Of these men, Hill would be claimed for themselves by the theoretical astronomers, along with Nathaniel Bowditch, translator and commentator of Laplace's "Mécanique Céleste," and Simon Newcomb, great perfecter of lunar and planetary theory; while Gibbs would be justly taken by physicists and chemists for their own. Thus there remains to the mathematicians of America only Benjamin Peirce for their undisputed possession. He appears as a kind of father of pure mathematics in our country. In his deep appreciation of the elegant and abstract we may recognize a continuing characteristic of American mathematics. In his concern with its many applications there resides a virtue which we are finding it more difficult to realize, because of the trend towards professional specialization. Without doubt, however, there is a spiritual necessity upon us to-day to regain a similar breadth of outlook.

Any account, however brief, of American mathematics before 1888 must chronicle an event of the preceding decade which was of extraordinary importance not only to mathematics, but to the whole field of scholarly endeavor, namely, the foundation of the Johns Hopkins University at Baltimore in 1876. Although the Graduate Schools of Yale University (1847) and of Harvard University (1872) were in existence, nevertheless, as has been said by Dr. Abraham Flexner in his book, "Universities: American, English, German," the Johns Hopkins University was the first American institution "consciously devoted to the pursuit of knowledge, the solution of problems, the critical appreciation of achievement, and the training of men at a really high level." Thus there was called to the new mathematical department at Baltimore the great English algebraist, James Joseph Sylvester, who remained there until 1884. Under the direction of the department there began in 1878 the *American Journal of Mathematics*, our first journal given over to mathematical research, and now completing its sixtieth year of high achievement. Ever since, there has continued to be at Baltimore, despite material limitations, an important center of mathematical activity, of which the staunch and kindly remembered British geometer, Frank Morley, was the titular leader from 1900 to 1928.

In all previous mathematical history perhaps no mathematical development in any country has been so extensive and rapid as that which ensued here upon the founding of the society. All the great nations of Europe had produced illustrious mathematicians of whom they had the right to be extremely proud. The French and German mathematical traditions were particularly well established and of incomparable brilliancy, represented at that moment by Henri Poincaré, the young David Hilbert and a number of other figures of very high rank. Italy and the Scandinavian countries were also flourishing vigorously. Yet up to that time there had scarcely arisen any occasion for European mathematicians to note the work of their American colleagues. A solitary exception was the early recognition of Hill's lunar theory by Poincaré, while the algebraic advances of Peirce failed to receive the attention which they deserved.

But now able young mathematicians, fresh from studies abroad, began to carry on vigorous and independent research at home, and their contagious enthusiasm soon aroused a deep interest in the younger men around them. Almost over night, as it were, the great University of Chicago sprang into existence in 1892, with a mathematical department made up of Eliakim Hastings Moore, Oskar Bolza and Heinrich Maschke from Germany, and others. Of these men, only Bolza is living to-day. They formed a notable and inspiring group which will ever be remembered in our mathematical annals. At about the same time Osgood and Bôcher, inspired by their German sojourn and in particular by the great Felix Klein of Göttingen, bent their every effort to strengthen the tradition at Harvard. Under the genial leadership of Moore at Chicago, who had studied with Gibbs at Yale University and for a year in Berlin, there was emphasized the abstract and algebraic side of mathematics, although Moore was remarkably catholic in his outlook. At Harvard attention was turned towards the vast field of analysis. The center in Cambridge was much strengthened by the transference of the Massachusetts Institute of Technology from Boston across the Charles River in 1916. Its mathematical group and that at Harvard University have been in close and mutually stimulating association since that date.

A few years later, under the wise and benevolent guidance of Dean Henry Burchard Fine, who had been strongly influenced by his studies under Leopold Kronecker, promising young men were called to the mathematical staff at Princeton, in particular L. P. Eisenhart, Oswald Veblen and J. H. M. Wedderburn. From that day forth there has always been an important mathematical group at Princeton. There came a notable further impetus with the founding there in 1930 of the Institute for Advanced Study, with Abraham Flexner as director. At the outset the new institute devoted its attention to the fields of mathematics and theoretical physics, calling at first Albert Einstein, Veblen and Hermann Weyl to ideal research posts. Up to the present time the mathematical staff of the institute has worked side by side with the staff of the university in Fine Memorial Hall. The others at the institute have in general already obtained their doctor's degree and come to enjoy a period of uninterrupted study and research under favorable conditions. The institute is fortunately able not only to augment its staff through distinguished temporary appointments, but also to give partial financial support to many of those who come to study.

By great good fortune I have been intimately associated with the centers at Chicago, Harvard and Princeton. I feel deeply indebted to them all. Indeed, there are not many American mathematicians who have not been profoundly influenced by one or another of these three groups. It was in the spring of 1902 that I made a first journey across the city of Chicago to the university, and found my way into the excellent mathematical library in Ryerson Physical Laboratory; before that time I had only been in contact with the mathematical books of the John Crerar Library and the small mathematical collection at Lewis Institute. I remember the thrill which the sight of the well-filled shelves gave me. Soon I met Professor Moore, of whom I had already heard, and found him then and always extraordinarily inspiring, suggestive and kind. During my first (junior) year at the university I profited much from my contact with Bolza also. At his suggestion I read the work of Gauss on the cyclotomic equation and the equally celebrated paper of Abel on the impossibility of solving the general quintic by radicals. Bolza's lectures were marvels of clarity and finish. But it was Moore above all who seemed to me to have the true fire of genius within him.

The year following I went to Harvard, with Moore's approval, for two years of study. There I learned more analysis, particularly from Osgood and Bôcher. I found Bocher's lectures the equal of Bolza's in lucidity and superior in placing important points in high relief. It was only later, however, that I came to realize how much I owed to Bôcher for his suggestions, for his remarkable critical insight and for his unfailing interest in the often crude mathematical ideas which I presented.

On my return to Chicago in the fall of 1905, I profited greatly by two further years of work with Moore, both in his seminar on analysis and outside the classroom. Moore was a deep admirer of Hilbert and was then following closely the rapid developments at Göttingen, attendant upon Fredholm's fundamental work in linear integral equations of 1900. It happened that I saw Moore's program of General Analysis taking shape day by day, as he came to appreciate the full abstract significance of the papers of Hilbert and the beautiful dissertation of Erhard Schmidt.

In 1907 I started teaching at the University of Wisconsin, and in my two years there I especially valued my scientific and personal relationship with my senior colleague, Edward Burr Van Vleck, whose distinguished son is now at Harvard as a member of the departments of physics and mathematics.

It was in the fall of 1909 that I became a member of the staff at Princeton. The presence of Veblen, nearly of my own age, with large ideas for American mathematics in general and for the Princeton Department in particular, meant much to me during my three years there. Veblen was then completing his important "Projective Geometry," volume 1, written in collaboration with J. W. Young, whom many will remember kindly. It was my privilege to read the book in page proof and to learn of Veblen's geometric program and ideas directly from him in our frequent walks and talks together.

I have recounted these personal circumstances only because I know that in their essence they are not very dissimilar to those of many American mathematicians.

In selecting Chicago, Cambridge and Princeton for especial reference I have realized fully that American mathematics reaches overwhelmingly beyond what is to be found in any three or even in any ten centers. And yet I think it is a comforting thought for American mathematicians everywhere to know that there are centers like these where scholarly conditions have been uniformly good and where high ideals have been steadily maintained. Such places, by their influence and example, support and stimulate mathematical scholarship and achievement throughout the whole of our country.

Concerning the other mathematical centers suffice it to say that there are now about thirty institutions where the advanced student of mathematics may go with advantage to study for the doctorate, while only fifty years ago he was forced to go to Europe to secure adequate training! Among the privately endowed institutions may be mentioned Brown, Bryn Mawr, California Institute of Technology, Chicago, Cincinnati, Columbia, Cornell, Duke, Harvard, Institute for Advanced Study, Johns Hopkins, Leland Stanford, Massachusetts Institute of Technology, Notre Dame, Princeton, Rice Institute and Yale; and among our state universities, California (at Berkeley and at Los Angeles), Illinois, Iowa, Michigan, Minnesota, Ohio State, Pennsylvania, Texas, Virginia and Wisconsin; and in Canada, the University of Toronto. The number of such centers should increase still further. All that is required in many cases is that mathematicians in a position of influence take the proper steps. As instances in point, I would cite what was done by Fine at Princeton and by Harris Hancock at Cincinnati.

The extraordinary contrast between 1888 and 1938 is equally manifested by the fact that fifty years ago there was a mere handful of competent mathematicians in the country, whereas there is now a body of over two thousand American members of our society. Among these, between one and two hundred have gone far beyond a doctoral dissertation to make important additions to mathematical knowledge, and some forty or fifty are highly creative with established international reputations. Later on I shall have occasion to refer to a number of these mathematicians and their specific contributions.

For the moment, however, I should like to direct attention to two interesting and important special groups. The first is made up of mathematicians who have shown the rare quality of leadership, of which Moore was an outstanding instance. Among the earlier of these I would mention the late eccentric geometer, George Bruce Halsted, who attracted to mathematics two notable figures, L. E. Dickson and R. L. Moore, both of whom in their turn have been able to exert a large personal influence. I would also mention with high esteem James Pierpont, who for many years was a source of inspiration at Yale. Among the other and younger men, besides Dickson, R. L. Moore and Veblen, the names of G. A. Bliss, G. C. Evans, Solomon Lefschetz, Marston Morse, J. F. Ritt, M. H. Stone and Norbert Wiener come to mind as having shown the same quality to an exceptional degree.

The second special group to which I wish to refer is made up of mathematicians who have come here from Europe in the last twenty years, largely on account of various adverse conditions. This influx has recently been large, and we have gained very much by it. Nearly all the newcomers have been men of high ability, and some of them would have been justly reckoned as among the greatest mathematicians of Europe. A partial list of such men is indeed impressive: Emil Artin, Solomon Bochner, Richard Courant, T. H. Gronwall, Einar Hille, E. R. van Kampen, Hans Lewy, Karl Menger, John von Neumann, Oystein Ore, H. A. Rademacher, Tibor Radó, J. A. Shohat, D. J. Struik, Otto Szász, Gabor Szegö, J. D. Tamarkin, J. V. Uspensky, Hermann Weyl, A. N. Whitehead, Aurel Wintner, Oscar Zariski.

With this eminent group among us, there inevitably arises a sense of increased duty toward our own promising younger American mathematicians. In fact, most of the newcomers hold research positions, sometimes with modest stipend, but nevertheless with ample opportunity for their own investigations, and not burdened with the usual heavy round of teaching duties. In this way the number of similar positions available for young American mathematicians is certain to be lessened, with the attendant probability that some of them will be forced to become "hewers of wood and drawers of water." I believe we have reached a point of saturation, where we must definitely avoid this danger.

It should be added, however, that the very situation just alluded to has accentuated a factor which has been working to the advantage of our general mathematical situation. Far-seeing university and college presidents, desirous of improving the intellectual status of the institutions which they serve, conclude that a highly practical thing to do is to strengthen their mathematical staffs. For, in doing so, no extraordinary laboratory or library expenses are incurred; furthermore, the subject of mathematics is in a state of continual creative growth, ever more important to engineer, scientist and philosopher alike; and excellent mathematicians from here and abroad are within financial reach.

Having thus glanced at our mathematical firmament which shines so brightly to-day, let us turn to survey briefly the general situation in our country which has made it possible. In the year 1888 there were probably about two hundred thousand students in our high schools and preparatory schools; to-day there are between five and six millions. This enormous increase is a consequence of the unquestioning belief in higher education which pervades our country. At the same time our colleges, universities and advanced technical schools have increased correspondingly in numbers and resources. There are to-day nearly a thousand such institutions scattered throughout our land, serving well over a million students, with a total physical plant staggering the imagination and representing billions of dollars of endowment. Probably the majority of these institutions struggle along under financial as well as educational difficulties, although rendering distinct service. But when all is said and done, there remain some two hundred and fifty of them which meet the exacting requirements of approval by the Association of American Universities.

As far as the mathematical side of this vast American enterprise of higher education is concerned, its magnitude is probably best appreciated by means of a different approach. The American Mathematical Society has a membership of over two thousand persons, the great majority of whom hold positions in our institutions of learning. Our highly esteemed sister organization, the Mathematical Association of America, devoted primarily to the interests of collegiate mathematics, has nearly twenty-five hundred members.

The conclusion then is plain. There must be between two and three thousand mathematical teaching positions in our higher institutions, with an average salary which must certainly lie between two to three thousand dollars. We see in this way that there is probably a sum of about six millions of dollars which goes each year to the support of higher mathematics!

Since the great war salaries have been increased and the teaching burden has been reduced, at least in the better institutions. I remember talking some twenty years ago with the late J. C. Fields, of Toronto, about the status of professors throughout the world; it will be recalled that Fields did more than any one else to bring about the important International Mathematical Congress held at Toronto in 1924. He told me that, after making a special study of the facts, he had come to the conclusion that the American professor was the worst treated of all! At that time there was much in his contention, even though there were already in existence a number of American professorial chairs where the salary was good and the teaching duties not excessive. To-day there are many such positions. In this connection it may be well to mention the fact that Harvard University has been able to reduce the amount of teaching and tutorial routine of the regular mathematical staff to six hours a week, of which only three hours are devoted to more or less elementary mathematical instruction. Such a schedule gives to all concerned a notable opportunity to carry on mathematical research, and would be socially unjustifiable unless the highest standards of achievement were being maintained. Although such ideal conditions are impracticable at present except in a few fortunate institutions, it should be strongly emphasized that twelve hours of instruction a week (including at least one course of advanced grade) is about all that can be required if the best standards of scholarship are expected. Indeed, wherever possible, the hours of instruction should be reduced to not more than nine, and if there are heavy outside duties there should be a compensating diminution in teaching.

But the situation has very definitely a complementary aspect. On our part there is an unescapable, deep responsibility to the nation which, somewhat unwittingly perhaps, has afforded us such splendid support. It is our duty to take an active and thoughtful part in the elementary mathematical instruction of our colleges, universities and technical schools, as well as to participate in the higher phases. To these tasks we must bring a broad mathematical point of view and a fine enthusiasm. In so far as possible we must actively continue as competent scholars and research workers. Only by so doing can we play our proper part.

It is interesting to note that the other material accessories useful for our extensive mathematical edifice have also been provided. With our *Bulletin* and *Transactions*, with the *American Journal of Mathematics*, all under society auspices, and with the *Annals of Mathematics*, the *Duke Mathematical Journal*, the *Journal of Mathematics and Physics* and the *American Mathematical Monthly*, we possess excellent facilities for the publication of original articles in periodicals. Aside from the *Journal of Mathematics and Physics* there is as yet no journal directed towards applied mathematics. More extensive publication in book form is afforded by our Colloquium Publications, and a similar new series in contemplation by the Institute for Advanced Study. For the prompt publication of short articles there is available the Proceedings of the National Academy of Sciences. There are in addition certain facilities to be found in the annual publications of learned societies (such as the American Academy of Arts and Sciences) and of higher institutions of learning (such as the Rice Institute Pamphlets), etc. Thus far, however, the commercial publishing houses of the country have not contributed much towards the publication of important advanced mathematical texts. In this respect they suffer by comparison with progressive European publishers, who take pride in the publication of significant mathematical books. The University Presses of the country have partly made up for this lack.

In addition to our regular meetings, the Colloquium Lectures, the annual Gibbs Lecture and the Visiting Lectures of the society provide important means for direct scientific interchanges among mathematicians. The coming International Congress of Mathematicians to be held at Cambridge in September, 1940, will present still other opportunities of this kind. In fact, the facilities for mathematicians to meet intimately with their colleagues at sister institutions are increasing constantly. The importance of such facilities in speeding up mathematical progress has long been recognized in European mathematical centers.

Then there is always the arduous administrative work of the society, carried on unselfishly by its officers and especially by its present secretary, Dean R. G. D. Richardson, true successor of Frank Nelson Cole. The way in which this work has been carefully and devotedly done without any paid officer has helped to unite the society more than anything else.

All in all, then, our American mathematical situation is about as favorable as can be hoped for on this very troubled planet. Our one real danger perhaps concerns the general standard of achievement. It is not enough for those who go into the rank and file of our colleges to devote themselves to a useful academic routine; they have a duty to live up to their highest mathematical potentialities and to awaken a deep mathematical interest in their students. It is not enough for the exceptional man, whose early work has led to a professional recognition, to take thenceforth an easy-going attitude; such a man should continue with the devotion of a leader in a great cause. Furthermore, we ought all to provide our share of first-rate elementary teaching, by which we justify our privileged positions in immediate practical terms. If we do these things, mathematics in America will rise to still greater heights and there will appear among us mathematical figures comparable to the greatest in the past.

OBITUARY

GUY N. COLLINS

Guy N. Collins, Principal Botanist in the Division of Cereal Crops and Diseases of the Bureau of Plant Industry in the U. S. Department of Agriculture, died on August 14, 1938, of endocarditis at his home at Lanham, Maryland. Mr. Collins was born at Mertensia, N. Y., on August 9, 1872. He attended Syracuse University, but terminated his college career as an undergraduate in 1895 to join a survey expedition to Liberia organized by Dr. O. F. Cook for the New York Colonization Society. While in Africa he indulged his interest and perfected his skill in photography with the result that all his travels and most of his work are photographically recorded. Pursuing this interest he later designed and patented the Naturalist's Camera, which made it possible for the first time expeditiously to photograph objects natural size in the field.

His plates of fresh specimens of fruits, flowers and sections of plants, reproduced full size, did much to stimulate this method of recording.

Following the vicissitudes of life in the tropical rain forests of the West Coast of Africa, in the days before the discovery of the relation of mosquitoes to malaria and yellow fever, he returned to the United States and spent a few months (in 1898) as a free lance botanical collector on the Florida Keys.

Shortly after the close of the Spanish-American War he joined the staff of the Office of Botanical Investigations in the U. S. Department of Agriculture as Assistant Botanist, and in company with Dr. O. F. Cook explored the newly acquired island of Puerto Rico. Their expedition resulted in the publication by the Smithsonian Institution of the still standard treatise entitled "Economic Plants of Porto Rico." At this time also Mr. Collins wrote "The Mango in Porto Rico," probably the handsomest bulletin ever issued by the Bureau of Plant Industry.

Returning from Puerto Rico he entered the Seed Laboratory of the Division of Botany and there devised much of the apparatus used for subdividing large lots of seeds into samples for germination and purity tests. He never lost interest in the statistical problems of seed testing and the means for determining the probable quality of a large lot of seed from the analysis of small subsamples. This interest was manifested many years later by the publication of a paper on "The Application of Statistical Methods to Seed Testing."

In 1901 he published the bulletin "Seeds of Commercial Salt Bushes." In this undertaking full use was made of his skill in photography, and the plates of seeds in that bulletin have never been equalled in excellence of detail.

Many expeditions to the American Tropics followed his trip to Puerto Rico, and from one of these came the introduction of the Guatemalan "hard-shelled" avocado, which has been utilized extensively in developing the commercial varieties of this fruit grown in Florida.

While on another of these expeditions to Southern Mexico, accompanied by C. B. Doyle, he collected at Acala the variety of cotton now grown extensively under that name in the Southwest. This variety is known for its superlative qualities and far exceeds in merit any other cotton of the Upland type.

On all these expeditions to the American Tropics Mr. Collins lived on and close to Indian corn, and it is not surprising that the diversity of this magnificent grass captured his fancy. Soon his own garden at Lanham was crowded with a collection of tropical maize, and he was not slow to recognize the usefulness of this plant in testing and extending Mendel's rediscovered laws of inheritance.

His first contribution to the literature of maize was printed in 1909, at which time he was Assistant Botanist in the Office of Bionomic Investigations of Tropical and Subtropical Plants in the Bureau of Plant Industry. From that time on, though his official title and administrative position went through many changes, his time was devoted to a study of inheritance in maize and to the application to that study of biometrical methods, without which, he was convinced, no adequate conclusions could be reached. The numerous papers on inheritance in maize, published chiefly by the U. S. Department of Agriculture, constitute a permanent record of his achievements in research.

Mr. Collins was among that early group of investigators whose work provided the foundation on which rests the present popular system of producing commercial corn crops from hybrid seed. However, his interest in the commercial utilization of hybrid seed was limited to the methods of determining the best combinations of strains and to the technique of producing such combinations.

The study of inheritance in maize led quite naturally to an interest in the origin of this crop and an interest in the American Indians who developed it. Consequently his articles on the phylogeny, agricultural history and origin of maize are definite contributions to this subject, ranking equally in importance to his contributions to maize heredity.

His insistence on the use of biometry not only on his own data but on those of his associates in the Bureau of Plant Industry compelled him to contribute much of his time to other investigators, at that time feeling their way through the labyrinth of statistical methods. In this manner he made contributions to much of the research of his colleagues. His was the first division in the Department of Agriculture to utilize the now common Hollerith tabulating machines.

Mr. Collins was devoted to the billiard table with its fascinating geometrical and psychological problems and was an ardent baseball fan. Confined to his home by his last illness he undertook with the aid of the radio to determine whether left-handed pitchers were more effective against left-handed batters than against right-handed batters, as is claimed by most team managers. This study was not completed.

Mr. Collins was highly regarded by his colleagues for his absolute honesty and for the objectivity with which he approached all problems whether of a personal or scientific nature. He was always patient and tolerant, particularly with younger workers to whose projects he was ever ready to contribute both advice and assistance.

To his staff he was a father confessor whose ready sympathy and understanding lightened many a burden.

In his death biological science has lost a great spirit, always fired with enthusiastic curiosity on scientific questions and tempered with a reasonableness that can come only with the highest intellectual development.

Mr. Collins is survived by his widow, Christine Collins, and two sons, George Briggs Collins, Assistant Professor of Physics at the University of Notre Dame, South Bend, Indiana, and Perez Hathaway Collins, of the Engineering Department of the Dye Works Division of the du Pont Company, Wilmington, Delaware.

J. H. KEMPTON

BUREAU OF PLANT INDUSTRY,
U. S. DEPARTMENT OF AGRICULTURE

RECENT DEATHS AND MEMORIALS

EDWARD MURRAY EAST, professor of genetics at Harvard University, died on November 9 at the age of fifty-nine years.

JOHN HENRY NEFF, professor of urology at the University of Virginia, died by suicide on November 9. He was fifty-one years old.

THE following deaths are noted in *Nature:* Sir John Griffith, president of the Institution of Civil Engineers in 1919, on October 21, aged ninety years; George Jennison, formerly owner and principal curator of the Belle Vue Zoological Gardens, Manchester, on October 21, aged sixty-six years; Colonel J. Clibborn, formerly principal of the Thomason Engineering College, Rorkee, known for his work in connection with irrigation in northern India, on October 31, aged ninety years.

IN honor of the late Dr. C. H. Eckles, chairman of the department of dairy husbandry at the Missouri College of Agriculture from 1901 to 1919, who died on February 13, 1933, the Board of Curators of the university has announced that the new dairy husbandry building will be named Eckles Hall.

SCIENTIFIC EVENTS

UNITED STATES STANDARDS IN ARGENTINA

THE Board of Directors of the American Standards Association has taken favorable action on a proposal that a permanent staff representative be stationed in Buenos Aires for the purpose of promoting American standards and other standards now in use by American industry. The decision of the board to take this action was based largely on the recommendations of a group of manufacturing concerns, trade associations and technical societies that met last June to discuss the need of a better knowledge of American industrial standards in South America. The fact that British, German and other interests have for some time been active in encouraging adoption of their standards had already brought forth suggestions from the U. S. Chamber of Commerce at Buenos Aires that American interests should also be represented.

Argentina, primarily an agricultural country, is the market for many American-made products. With the exception of Canada, it provides the leading outlet for motor trucks. It is the seat of several large American-owned meat-packing plants. North American oil companies have an interest in Argentina's petroleum business. Such firms as Goodyear, Firestone, Michelin and Dunlop manufacture tires in the country; du Pont has a rayon factory there and is also bidding for a share of the country's chemical business. The International Telephone and Telegraph Company counts Argentine business as its largest single foreign investment. In this situation a better understanding of American industrial standards has been felt to be an important factor in our future business relations with the country.

The action taken by the A. S. A. Board is contingent upon the guarantee of sufficient funds to support the work by the concerns interested in the project. A committee, consisting of L. J. Briggs, director, National Bureau of Standards; C. L. Collens, president, Reliance Electric and Engineering Company; Howard Coonley, chairman of board, Walworth Company, and R. E. Zimmerman, vice-president, U. S. Steel Corporation, has been appointed to draw up a possible budget and to determine definitely whether and from what sources financial support may be forthcoming. This committee will also, with the advice and collaboration of the National Foreign Trade Council and of those American firms participating in the financial program, assist in the selection of the proposed representative. This representative, who will be stationed at Buenos Aires, will undoubtedly look for considerable supervision and guidance in his work to the American Chamber of Commerce at Buenos Aires, which has expressed itself as exceedingly interested in the project.

THE ANNUAL MEETING OF THE AMERICAN SOCIETY OF MECHANICAL ENGINEERS

The fifty-ninth annual meeting of the American Society of Mechanical Engineers will be held at the Engineering Societies Building in New York City from December 5 to 9. It will present the latest developments in the fields of machine tools, steam power, aeronautics, management, safety, metals, fuels, instruments, textiles, hydraulics, lubrication, railroads, research and ordnance.

Engineers from all parts of the world will attend the meeting to present the results of their work in all phases of mechanical engineering, with particular emphasis on high speed, high pressure, high efficiency and high temperature. For each engineer who speaks, it is expected that there will be twenty-five others in attendance.

During the week, delegates from the seventy-one local sections of the society in the United States and Canada will meet to discuss ways and means of increasing the usefulness of the society, which has now 15,000 members, to the individual member and to his community. A conference will be held for the purpose of correlating the activities of the divisions so as better to promote the art and science of mechanical engineering as a whole. The society at present is made up of seventeen divisions: Aeronautics, Applied Mechanics, Fuels, Graphic Arts, Heat Transfer, Hydraulics, Iron and Steel, Machine Shop Practice, Management, Materials Handling, Oil and Gas Power, Petroleum, Power, Process Industries, Railroad, Textile and Wood Industries.

Besides the technical sessions, there will be a business meeting on Monday afternoon, December 5, and several luncheons and dinners. The chief social events are: Honors Night on Tuesday evening, December 6, when awards and medals will be presented, and the annual dinner on Wednesday evening, December 7.

THE MATHEMATICAL ASSOCIATION OF AMERICA

The twenty-third annual meeting of the Mathematical Association of America will be held at Richmond and Williamsburg, Virginia, from Tuesday to Saturday, December 27–31, in conjunction with the meeting of the American Association for the Advancement of Science, the American Mathematical Society and the National Council of Teachers of Mathematics.

The association will meet jointly with Sections A and E of the American Association for the Advancement of Science and the society on Wednesday morning in Richmond and will hold a joint session with the National Council at Williamsburg on Friday afternoon and a separate session on Saturday morning, when the annual business meeting will be held. The Program Committee is planning three addresses for the Saturday morning session.

The American Mathematical Society will hold sessions on Wednesday morning in Richmond and on Wednesday afternoon through Friday morning in Williamsburg; on Thursday afternoon President R. L. Moore will deliver his retiring address, "On Certain Abstract Spaces." The National Council will hold on Friday morning a section on arithmetic and a secondary section on school mathematics; at the joint session on Friday afternoon addresses on teacher training will be given by Professors A. A. Bennett, F. L. Wren and R. L. Morton.

On Tuesday evening, in Richmond, Dean G. D. Birkhoff, of Harvard University, will deliver his address as retiring president of the American Association for the Advancement of Science on "Intuition, Reason and Faith in Science." This is the opening meeting of the association.

In the Broadcasting Studio of the Mosque, Richmond, at 9:30 A.M., on Wednesday, Professor W. D. Cairns, of Oberlin College, will deliver his retiring address as vice-president of the American Association for the Advancement of Science and chairman of Section A before a joint session of Sections A and E, the American Mathematical Society and the Mathematical Association. His subject will be "Seismology from a Mathematical Viewpoint." At 10:45 Professor H. A. Rademacher, of the University of Pennsylvania, will make an address on "Fourier Expansions of Modular Functions and Theorems on Partitions" at a joint session of Section A, the Mathematical Society and the Mathematical Association. At the Mosque at 11:00 A.M., on Wednesday, Professor R. C. Archibald, of Brown University, will deliver his retiring address as vice-president and chairman of Section L. He will speak on "Mathematicians, and Poetry and Drama."

AWARD OF THE PENROSE MEDAL TO PROFESSOR LAWSON

THE Penrose Medal, the highest honor of the Geological Society of America, has been awarded to Dr. Andrew Cowper Lawson, professor emeritus of geology and mineralogy at the University of California, "for eminent research in pure geology, and outstanding original contributions and achievements which mark a decided advance in the science of geology."

Dr. Lawson, authority on earthquake phenomena and continental border movements, is the tenth recipient of the medal since its founding in 1927 by the late Dr. R. A. F. Penrose, Jr., of Philadelphia. Presentation will be made at a dinner at the Waldorf-Astoria Hotel, New York City, on December 30 during the semi-centennial meeting of the society.

Engaged in many different phases of research in geology since 1882, Dr. Lawson has studied and published reports on numerous regions of the United States and Canada. After the great California earthquake in 1906 he organized and directed investigations in seismology, advancing the science of predicting earthquakes. He has recently devoted much attention to fundamental theories concerning the nature and process of certain types of earth movements, and is author of a series of papers on the applications and implication of the theory of isostasy, a subject involving the theoretical condition of equilibrium which the earth's surface assumes under gravitation. He has been on the faculty of the University of California for forty-eight years.

Dr. Lawson was born in Anstruther, Scotland, on July 25, 1861. He was graduated from the University of Toronto in 1883. He took the master of arts degree at Toronto in 1885, and the doctor's degree at the Johns Hopkins University in 1888. Harvard University conferred the honorary degree of science upon him in 1936, the University of Toronto having similarly honored him in 1923. He received the honorary degree of doctor of laws from the University of California in 1934.

He became assistant professor of mineralogy and geology at the University of California in 1890, having been on the Canadian Geological Survey eight years. In 1892 he was named associate professor, and in 1899 full professor, continuing until his retirement from active duty in 1928. He was dean of the College of Mining from 1914 to 1918. Besides being chairman of the California State Earthquake Committee in 1906, he was a member of the U. S. Assay Commission in 1916; chairman of the Division of Geology and Geography of the National Research Council in 1923–24, and delegate to the International Geological Congress in 1888 in London, 1897 in St. Petersburg, 1913 in Toronto and 1928 in Madrid.

Dr. Lawson was president of the Geological Society in 1926, vice-president in 1908, chairman of the Cordilleran Section from 1906 to 1912 and secretary of the same section from 1899 to 1906. He was president of the Seismological Society of America in 1909. He is also a member of the American Association for the Advancement of Science, the American Institute of Mining and Metallurgical Engineers, the American Academy of Arts and Sciences, the American Philosophical Society and the National Academy of Sciences.

The award committee, in addition to Dr. Vaughan, was composed of Professors Nevin M. Fenneman, of the University of Cincinnati; Douglas Johnson, of Columbia University; Donald H. McLaughlin, of Harvard University; Adolph Knopf, of Yale University; John P. Buwalda, of the California Institute of Technology, and James Gilluly, of the University of California at Los Angeles.

Previous recipients of the medal have been: Thomas C. Chamberlin, 1927; Jakob J. Sederholm, 1928; Francois A. A. Lacroix, 1930; William M. Davis, 1931; Edward O. Ulrich, 1932; Waldemar Lindgren, 1933; Charles Schuchert, 1934; Reginald A. Daly, 1935, and Arthur P. Coleman, 1936. No medal was awarded in 1929 and 1937.

SCIENTIFIC NOTES AND NEWS

THE Nobel prize in physics has been awarded to Professor Enrico Fermi, of the University of Rome, "in recognition of his discovery of new elementary radioactive substances engendered by irradiation of neutrons." It is announced that Nobel prizes for physiology and medicine and for chemistry will not be awarded this year.

THE following awards of medals have been made by the President and Council of the Royal Society, London: The Copley Medal to Professor Niels Bohr, For.Mem.R.S., in recognition of his distinguished work in theoretical physics and particularly in the development of the quantum theory of atomic structure. The Rumford Medal, as announced in SCIENCE last week, to Professor R. W. Wood, For.Mem.R.S., in recognition of his distinguished work and discoveries in many branches of physical optics. The Davy Medal to Professor G. Barger, F.R.S., in recognition of his distinguished researches on alkaloids and other natural products. The Darwin Medal to Professor F. O. Bower, F.R.S., in recognition of his work of acknowledged distinction in the field in which Darwin himself labored. The Hughes Medal, awarded jointly to Dr. J. D. Cockcroft and Dr. E. T. S. Walton, in recognition of their discovery that nuclei could be disintegrated by artificially produced bombarding particles.

Dr. Irvin Abell, of Louisville, president of the American Medical Association, received on November 5 the Laetare Medal, awarded annually by the University of Notre Dame to an outstanding Catholic layman.

The Norman Medal of the American Society of Civil Engineers has been awarded to Professor Hunter Rouse, of the California Institute of Technology, for his work on the mechanics of fluid turbulence.

On the occasion of the fiftieth anniversary of Goucher College, Baltimore, the degree of doctor of laws was conferred on Dr. Margaret Reed Lewis, of the department of embryology of the Carnegie Institution at the Johns Hopkins University; on Dr. Madge Thurlow Macklin, of the Medical School of the University of Western Ontario, and on Dr. Florence Barbara Seibert, of the Henry Phipps Institute of the University of Pennsylvania.

Dr. C. L. Huskins, professor of genetics at McGill University, has been granted leave of absence for the autumn term to enable him to become visiting professor of botany at the University of California. He will take over the courses in cytology during the absence of Professor T. H. Goodspeed, now directing a botanical expedition into South America. Dr. R. M. Love, of the Cereal Division, Central Experimental Farm, Ottawa, has been appointed sessional lecturer in genetics at McGill University. Dr. Sheldon C. Reed has been made acting chairman of the department.

Dr. Peter Gray, lecturer in embryology at the University of Edinburgh, has been appointed associate professor of biology at the University of Pittsburgh. He will take up the work at the beginning of the next semester.

Following a year spent at the University of Oxford on a Guggenheim fellowship, Dr. Lawrence Olin Brockway has been appointed assistant professor of chemistry at the University of Michigan.

Dr. Harry R. DeSilva, lecturer in psychology at Harvard University, has been appointed research associate in psychology at Yale University. He will have charge of a program of Automobile Driver Research in the Institute of Human Relations. Research on drivers will be carried out by a staff in cooperation with neighboring motor vehicle departments. The work is made possible by a grant to Yale University from the recently established Esso Safety Foundation.

Dr. G. L. Freeman has been promoted to an associate professorship of psychology at Northwestern University. James Egan and Louis Krasmo have received research appointments in the Laboratory of Psychophysiology.

Dr. H. S. W. Massey has been appointed from January 1, 1939, to the Goldsmid chair of mathematics tenable at University College, London. Since 1933 he has been lecturer in mathematical physics at Queen's University, Belfast.

Dr. Robert K. Enders, of the Edward Martin Biological Laboratory of Swarthmore College, has been promoted to an associate professorship and has been granted leave for the year 1938–1939. He will be stationed at Swarthmore College, where he will continue, as biologist of the Bureau of Biological Survey, to work on the reproductive cycle of the mink. This project is supported by a grant from the Bankhead-Jones Special Research Fund.

Clarence Beaman Smith, assistant director of extension work and chief of the Division of Cooperative Extension of the U. S. Department of Agriculture, retired on October 31. He had been in the department for forty-two years, thirty of which were in connection with extension work.

James R. Killian, Jr., editor of the *Technology Review*, has been appointed to fill the newly established post of executive assistant to the president of the Massachusetts Institute of Technology, Dr. Karl T. Compton. Mr. Killian will participate in the administration of the institute and will take over some of the responsibilities which have been carried by Vice-president Vannevar Bush, who on the first of the year becomes president of the Carnegie Institution of Washington. He will also be chairman of the Board of Publications of the Technology Press. Mr. Killian was for three years secretary of the board of publications of the American Chemical Society.

The Lord President of the Council of the British Department of Scientific and Industrial Research has appointed Dr. G. Stafford Whitby, at present director of the division of chemistry of the National Research Council, Canada, formerly professor of chemistry at McGill University, to be director of the Chemical Research Laboratory, Teddington, in succession to Sir Gilbert Morgan, who retired on September 10. Dr. Whitby is expected to take up the work early in 1939.

A GRANT of $600 has been awarded to Dr. Frank J. Studer, of the department of physics at Union College, by the American Institute of Electrical Engineers for fundamental research on the physics of resistance welding.

DR. ROBERT L. STARKEY, of the New Jersey Agricultural Experiment Station, has returned after a year's work in the laboratory of Professor Kluyver at Delft, Holland.

J. C. HENING, associate in dairy research at the New York State Experiment Station at Geneva, has returned from a six-months' leave, during which he worked at the Dairy Research Institute of the University of Reading, England.

PROFESSOR ALBERT EINSTEIN will be chairman of the Advisory Committee on Science of the New York World's Fair, which will cooperate in preparing a central exhibit of science. Other members of the committee are: Dr. Robert Chambers, of New York University, zoology; Dr. Karl T. Compton, president of Massachusetts Institute of Technology, physics; Gano Dunn, of J. G. White Engineering Corporation and president of Cooper Union, industrial research; Dr. Frank B. Jewett, vice-president of the American Telephone and Telegraph Company, industry; Waldemar Kaempffert, *The New York Times*, the public; Paul B. Mann, Evander Childs High School, New York City, children's interests; Professor R. H. McKee, Columbia University, chemistry; Charles F. Roth, manager of the Grand Central Palace, New York City, industrial exposition technique; Professor Edmund W. Sinnott, Columbia University, botany, and Dr. Gerald Wendt, director of science at the fair, who will act as secretary to the committee.

PROFESSOR NIELS BOHR, of the University of Copenhagen, will lecture at the Institute for Advanced Study at Princeton. He plans to give one formal lecture a week from January 17 to May 1, under the title, "Elements and Principles of Atomic Theory."

DR. RAYMOND PEARL, of the School of Hygiene and Public Health of the Johns Hopkins University, was in residence at Indiana University from September 27 to November 15. He conducted a number of seminars and gave a series of five public lectures on "Man the Animal." This was the first series of lectures under the Patten Foundation established in 1936.

DR. ARNO B. LUCKHARDT, professor of physiology at the University of Chicago, gave the annual N. W. Jones lectures on November 2, 3 and 4, at the University of Oregon Medical School. His subjects were: "Dr. Wm. Beaumont and the Beaumont Memorabilia of the University of Chicago"; "Academic or Unsuccessful Research"; and "A Neglected Chapter in Anatomic Illustration and Instruction."

DR. GEORGE SARTON, lecturer at Harvard University on the history of science and editor of *Isis* and *Osiris*, journals of the history of science, lectured on November 9 on "The Function of Academies—Past and Present," before the American Academy of Arts and Sciences, Boston.

DR. WENDELL MEREDITH STANLEY, of the department of animal and plant pathology of the Rockefeller Institute for Medical Research at Princeton, N. J., gave on November 14 an address before the New York Academy of Sciences entitled "The Nature of Viruses."

DR. K. LARK-HOROVITZ writes: "In my recent review on new text-books in physics (SCIENCE, October 14, page 354), I discussed the excellent new text of R. A. Millikan and collaborators. Unfortunately I quoted the book as Millikan and Roller. I hasten to correct this mistake, which has been pointed out to me by several colleagues—the actual authors of this book are R. A. Millikan, D. Roller and E. C. Watson."

A PRESS dispatch from San Francisco, Calif., dated November 10, reports that California voters administered an overwhelming defeat to a state proposition which would have prohibited the use of impounded animals for medical purposes. With most of the precincts counted, the vote was 560,795 favoring the proposition, and 1,164,097 against it.

DR. ELLIOTT C. CUTLER, Moseley professor of surgery, Harvard Medical School, and chairman of the American Medical Association Committee for Protection of Medical Research, writes to Science Service: "The defeat of the so-called humane pound initiative measure in California will encourage all scientific bodies, defenders of biological research, and doctors everywhere to continue their investigations for the betterment of the health of the American people. The defeat on this bill is a clear indication that the public as a whole believes in defending the frontiers of knowledge and in training doctors in technical methods in surgery through the use of animals. It is to be hoped that the recent defeat to the misguided sentimentalists in their attempt to embarrass and hinder medical research will lead people to appreciate that the promise of future improvements in public health matters and the discoveries which will better their welfare will largely depend upon the freedom with which scientists may conduct investigations."

THE National Research Council has subscribed to a table in the Stazione Zoologica di Napoli. Biologists desiring to avail themselves of the use of this table in the near future should write to the Division of Biology and Agriculture, National Research Council, Washington, D. C. The award of the table will be in the hands of a committee of the division, consisting of the representative to the Division from the American Society of Zoologists, chairman, the president of the American Society of Zoologists, the president of the Botanical Society of America and the chairman of the Division of Biology and Agriculture, National Research Council, *ex officio.*

THE College of Medicine of the State University of Iowa announces a gift of $22,500 from the John and Mary R. Markle Foundation, to be spent over a two-year period; $12,500 of the fund will provide for a continuation of the research on inflammatory conditions of the eye in the department of ophthalmology under Dr. C. S. O'Brien, and the remainder will be used to continue the research program on blood clotting and the bleeding tendency in the department of pathology under Dr. H. P. Smith.

THE Committee on Scientific Research of the American Medical Association has recently awarded grants to Dr. Rucker Cleveland, of the department of anatomy, Vanderbilt University School of Medicine, for research on the cytology of the endometrium; to Dr. A. R. Buchanan, professor of anatomy, University of Mississippi Medical School, to be used for research on the vestibular mechanism in monkeys; to Dr. E. Spiegel, of the School of Medicine of Temple University, Philadelphia, for work on "physicochemical factors influencing the excitability of the central nervous system"; to H. D. West, associate professor of biochemistry at Meharry Medical College, Nashville, Tenn., for the continuation of his work on the synthesis of dl-threonine; to Dr. Charles F. Code, of the department of physiology of the University of Minnesota, for his work upon the histamine content of blood in normal and certain abnormal conditions; to Dr. A. Emge, of Stanford University School of Medicine, for further studies on the relation of sex hormones to tumor growth; to H. E. Carter, assistant professor of biochemistry at the University of Illinois, for the study of betaines of aminohydroxyl acids, and to Dr. Alexander Levy, for experimental work in the field of chest surgery, to be carried on in the department of surgery of the Medical School of the University of Oregon.

APPLICATIONS for the position of principal industrial toxicologist (organic compounds) in the U. S. Public Health Service, at a salary of $5,600 a year, must be on file with the U. S. Civil Service Commission at Washington, D. C., on November 28.

THE School of Mathematics of the Institute for Advanced Study each year allocates a small number of stipends to gifted young mathematicians and mathematical physicists for the purpose of enabling them to broaden their scientific outlook and to work on their research programs at Princeton in contact with the members of the institute and university faculties. Only such candidates will be considered as have already given evidence of ability in independent research comparable at least with that expected for the degree of doctor of philosophy. Applications for the academic year 1939–40 should be filed before February 1, 1939. Blanks for this purpose may be obtained from the School of Mathematics, The Institute for Advanced Study, Fine Hall, Princeton, N. J.

ANNOUNCEMENT has been made by the Finney-Howell Research Foundation, Inc., that all applications for fellowships for next year must be filed in the office of the foundation, 1211 Cathedral Street, Baltimore, Md., by January 1. Applications received after that date can not be considered for 1939 awards, which will be made on the first of March. This foundation was provided for in the will of the late Dr. George Walker, of Baltimore, for the support of "research work into the cause or causes and the treatment of cancer." The will directed that the surplus income from the assets of the foundation together with the principal sum should be expended within a period of ten years to support a number of fellowships in cancer research, each with an annual stipend of two thousand dollars, "in such universities, laboratories and other institutions, wherever situated, as may be approved by the Board of Directors." Ten such fellowships were awarded in 1938. Fellowships carrying an annual stipend of $2,000 are awarded for the period of one year, with the possibility of renewal up to three years; when deemed wise by the board of directors, special grants of limited sums may be made to support the work carried on under a fellowship.

A SIXTEEN unit display entitled "The March of Life" will make up the exhibit of the University of California Medical School at the Golden Gate International Exposition in 1939. The presentation will show what medicine and surgery have accomplished since the time of Hippocrates and, in addition, demonstrate the services rendered by the university's medical center to its own students.

DISCUSSION

A MEASURE OF THE FLIGHT CAPACITY OF GRASSHOPPERS

THAT grasshoppers have a most effective means of relieving congestion in one quarter and contributing to it in another is indicated by the results of a recent study conducted by the North Dakota Agricultural Experiment Station.

For some years it has been apparent that localized outbreaks of grasshoppers, when inadequately checked by control agencies, tend to spread rather rapidly over wide areas. In other words, the problem of controlling grasshoppers may change from that of a few spotted or localized outbreaks to a statewide, regional or international problem in the course of a few years, as is the case in the present grasshopper situation of the Great Plains area.

To secure definite information on the speed and direction of grasshopper dispersal upwards of 100,000 grasshoppers were sprayed with a fast-drying red lacquer and released on July 17 a few miles west of LaMoure in southeastern North Dakota. A cage of the marked grasshoppers kept under observation showed no ill effects of the treatment and appeared to behave similarly to unmarked individuals. Two days following the release, four of the marked specimens (three *Melanoplus mexicanus* and one *Melanoplus differentialis*) were recovered near Nortonville at a point 20 miles northwest of the place where the grasshoppers were released. Subsequent recoveries included only the more migratory grasshopper, *M. mexicanus* (see Table 1).

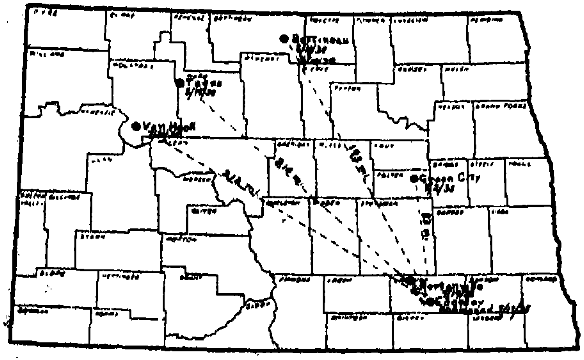

FIG. 1. Flight dispersal of grasshoppers.

TABLE 1

Number of specimens	Date and place of capture	Distance traveled	Number of days	Name of collector
		miles		
1	July 31—Van Hook	215	14	Mrs. John Murray
1	Aug. 2—Grace City	86	16	Orrin Topp
2	" 10—Bottineau	193	24	Mrs. W. D. Williams
1	" 11—Bottineau	193	25	V. H. Florell
1	" 14—Tagus	214	28	Jean Engen

The few recoveries verified to date have ranged from north to northwest from the point of release. A possible explanation of this may be that winds from the south and southeast, being warmer than those from the other directions, were more effective in promoting sustained flight of the insects. U. S. Weather Bureau records reveal that for 18 days of the 29-day period, beginning on July 17, winds from the south and southeast prevailed with an average daily maximum temperature of 88.9° F. For the remaining 11 days, which included 7 in July and 4 in August, the winds from the north and northwest prevailed with an average daily maximum temperature of 79° F.—a difference of 9.9° F. lower than the warmer winds from the south. The average velocity of the southern winds averaged 7.04 miles per hour, while those from the northerly directions averaged 8.1 miles. The heavy flights were generally observed to be traveling with the prevailing winds from the south.

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AUTHORITY CITATIONS AGAIN

THE discussion of authority citations by Donald Culross Peattie and Arthur Paul Jacot is very timely, for it appears that in some instances this device augments the confusion instead of diminishing it. This is particularly true if the original authorities did not publish their descriptions. In such cases the names get into circulation by exchange of material, and their ultimate publication is by a different author. Thus the specific names of Solander first appeared in Dillwyn's catalogue, and when Solander's name is quoted, as it frequently is, it gives no clue to the location of the original description in print.

Often the real meaning of a generic name is fixed, not by the original description, but by the type designation, which not infrequently is by a later author, in which case it is impossible to refer to the description and designation both without having recourse to a double citation, undesirable and awkward as such a practice may be.

My own feeling is that what is needed is a periodical that would perform the functions of a biological nomenclator, in which might be published references to descriptions, type designations, synonymies, etc., and to which reference might be made in lieu of to an "authority." For lack of such a medium students have been compelled to publish material of this sort in divers scattered places, where it is inappropriate, difficult of access and takes up space that increases the cost of publication.

It is to be hoped that biologists will succeed in devising some way by which material of purely nomenclatorial interest and significance can be concentrated in one place, where it will be available when needed.

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the medium sized to large bays and that there is an absence of well-defined spot highs in areas away from the influence of the bays. The distribution of bays is restricted geographically, but in areas in which they occur, there seems to be no relationship to topography or rock character. Bays are elliptical with definite orientation. Sinks are irregular in shape and orientation. In soluble rock areas some bays have been modified by solution; such "bay-sinks" are sand-rimmed and distinguishable from sinks. Various "bay-sinks" suffer solution-elongation in various directions. The size of bays is independent of topography and solubility of rock. Movement of sands in bay areas is in general northeast as shown in present shape of bays and relation of sand-rims and dune areas to the bays. Section of two small, overlapping bays by the Intercoastal Waterway, near Myrtle Beach, furnishes a comparative study of sub-surface conditions in peat-filled elliptical bay area and peat-filled irregular shaped swamp areas nearby. Only under elliptical bay area is the underlying impervious clay layer penetrated by swamp water in sufficient quantity to dissolve the two fossil shell beds below. In conclusion it can be said that the latest investigations concerning the origin of "Carolina Bays" still further support the modified meteoric theory of their origin. All present known facts concerning the bays as observed by the writer seem to fit into this theory.

Changes in shape accompanying tetraploidy in cucurbit fruits: E. W. SINNOTT and A. F. BLAKESLEE. The most commonly observed differences between members of a polyploid series in plants have been the size differences resulting from the increased cell size which follows an increase in number of chromosome sets. That such changes may be accompanied by qualitative ones is shown by the marked differences in fruit shape between diploid races of various cucurbits and tetraploid races produced from them by treatment with colchicine. In every case the tetraploid fruit is distinctly shorter and wider than its corresponding diploid type. This result has been brought about both by changes in the shape of the early fruit primordium and in the relative growth rates of length and width during development. Races of *Cucurbita Pepo* and of *Lagenaria vulgaris* show this change, which is similar to that previously reported for capsule shape in Datura. Why an increase in chromosome number and cell size, with no alteration in genetic constitution, should produce such a specific change in form presents an important morphogenetic problem.

Observations on cilia of aquatic Phycomycetes: J. N. COUCH (introduced by A. F. Blakeslee). By staining with Loeffler's stain it has been found that the cilium of certain chytrids as *Rozella septigena* Cornu, *Woronina polycistis* Cornu, *Rhizophidium* (several species), *Cladochytrium replicatum* and other undescribed forms is composed of the long, rather thick, basal part which one can see by the usual staining technic and in addition a thin distal part which is invisible on the living spore and even when stained by the usual cilia stains. *Monoblepharis regignens* and *Allomyces moniliformis* have the same type of cilium. It seems highly probable that it is the thin part of the cilium that propels the spore, the thick part acting as a rudder. This kind of cilium is usually correlated with the absence of cellulose in the walls, but in certain undescribed forms the cell walls are of cellulose. Such chytrids with cellulose walls have given rise to no higher types but represent an offshoot from the main chytrid line. A second type of cilium occurs in *Rhizidiomyces apophysatus* and an undescribed genus which we have in culture on agar. Here the uniciliate spore lacks the thin distal part of the cilium, but frequently shows short, thin, lateral appendages. This kind of cilium is correlated with the presence of cellulose in the walls. It is unlikely that any of the existing higher Phycomycetes are derived from this line, for the higher forms all possess biciliate zoospores. A third type of ciliation has been recognized in the Phycomycetes. In an undescribed genus (an endo-parasite in the threads of an *Achlya*) closely related to the potato parasite, *Spongospora*, the spores have two cilia, one long, the other short, the short cilium having a long thin appendage. In *Olpidiopsis* sp. on *Achlya* a similar appendage has been found on one of the cilia, both of which are of about the same length. In *Pythium aphanidermatum* both cilia possess short, thin appendages, and in *Saprolegnia* and *Achlya* the thin appendages may usually be seen on one or both cilia. These studies indicate at least three lines of evolution in the aquatic Phycomycetes: (1) the chytrid-*Monoblepharis* line; (2) the *Rhizidiomyces* line; and (3) the biciliate line terminating in such forms as *Saprolegnia* and *Pythium*.

Interspecific grafts and mixtures among the Dictyosteliaceae: KENNETH B. RAPER (introduced by Charles Thom).

The structural organization of cellulose in cotton fibers: DONALD B. ANDERSON (introduced by Edmund W. Sinnott). The wall of the cotton fiber is composed of very minute thread-like strands of cellulose which anastomose freely with each other, forming a close-meshed network. In the oldest layer of the cell wall the cellulose strands are oriented in flat spirals, but in subsequent deposits the strands wind in steep spirals which frequently reverse their direction. The structural organization of the cellulose units in the wall does not appear to be influenced by environmental factors, but the rate at which the cellulose is deposited is subject to environmental control. It is possible, therefore, to control the apparent stratification in the wall of the fiber or to eliminate it completely by regulating the temperature and light during the period of cell wall thickening.

Downy mildew of tobacco: FREDERICK A. WOLF (introduced by R. A. Harper). Downy mildew of tobacco seedlings first appeared in Florida in 1921 and was eradicated only to reappear in 1931. The disease now involves nearly all tobacco-growing areas in the eastern United States and southern Canada. It is caused by *Peronospora taba-*

cina, a fungus having a sporangial stage by which it is disseminated and an oosporic stage by which it survives from one year to the next. Sporangia are formed at daybreak and are air-borne. Oospores constitute the inoculum for primary infections. Seed beds that occupy the sites of old infected beds are foci of infection. The severity and course of downy mildew are governed by weather conditions, cold, rainy, cloudy periods being especially favorable. Infection may be completely prevented or the disease may be checked, once it has begun, by use of benzol vapors. The minimal concentrations of benzol vapor that are effective have been determined. The modificatory influence of moisture, temperature, porosity of covers, amount of benzol applied, wind velocity and surface area of evaporators, upon treatment of seedlings with benzol vapors, has also been evaluated.

A saprophytic alga: W. C. Coker and Leland Shanor (introduced by E. D. Merrill). At two stations in northern Chatham County, N. C., in small runs receiving seepage from a burning sawdust pile, we have found a remarkable plant having the appearance of a higher green alga but with the nutrition of a saprophytic fungus. It has a body closely resembling that of *Stigeoclonium*, but is entirely without chlorophyll or any trace of an organ resembling a chloroplast. The cytoplasm is confined to an extremely thin layer under the wall, and each cell has a large conspicuous nucleus. The tip cells of the branches are extremely tenuous and end in a fine point, which is found to be viscid. These tip cells fall off easily and attach themselves by their points to objects in the water. Reversing their polarity, they soon develop into a much-branched plant reaching a length of about 1 cm and having exactly the appearance of a vigorous water mold. This vegetative propagation by the distal cells is the only method of multiplication which the plant has, so far as known. A complicated group of rhizoidal holdfasts is sent off from the basal cell and from several cells above it. The cell walls are not of cellulose, which fact still further complicates the situation. Several parasitic alga-like plants that have quite or nearly lost their chlorophyll are known, but, so far as the writers are aware, no strictly saprophytic species with the form of an alga has ever before been found.

Concerning the acquired resistance of renal epithelium to bichloride of mercury: Wm. deB. MacNider. If the kidney of the dog be slightly injured by uranium nitrate the epithelium of the convoluted tubules at which point this metal has a selective action repairs itself by the formation of a normal type of epithelial cell for this location of the nephron. Such cells have no resistance to a secondary injury by uranium. If the epithelium in this segment of the tubule be severely injured by uranium nitrate the epithelial repair process results in the formation of a flattened or syncytial type of cell which is atypical for this segment of the tubule. Associated with the development of this atypical type of cell formation there is acquired on the part of such cells in this segment of the tubule a marked degree of resistance against uranium nitrate. When bichloride of mercury is administered to an animal it selects for its major point of action in the kidney the specialized epithelium found in the convoluted tubule. When animals have received a severe renal injury for uranium nitrate so that an atypical type of epithelial repair has developed in the convoluted segment of the tubule the use of bichloride of mercury fails to show any evidence of injury to such epithelium in this segment of the nephron. The observation would indicate that injury to epithelial tissue by one type of toxic agent may protect an epithelial tissue of repair from a toxic agent of another type, provided the processes of repair to the epithelial tissue from the injurious agent has led to the formation of a change in the morphology of the epithelial cells in the location at which the different types of injurious agents exert their nephrotoxic action.

The growth-promoting properties of certain cystine derivatives: James C. Andrews[1] (introduced by Wm. deB. MacNider). Although biological sulfur is chiefly introduced into the body as cystine and methionine and eliminated in the form of sulfates in the urine, the intermediate steps in this process are largely unknown. Sulfur metabolism may be arbitrarily divided into two main processes, both of which must take place before sulfates are produced: rupture of the bond between sulfur and carbon and oxidation of the sulfur to the hexavalent condition. One object of sulfur metabolism studies is to determine the order of these two reactions, the latter of which undoubtedly takes place in a series of steps. In judging the status of any given sulfur compound as an intermediary metabolite two criteria are used: ability of the compound to produce urinary sulfates and ability to substitute for cystine and methionine in supporting growth. The latter is by far the more exacting criterion since many inorganic sulfur compounds readily oxidize to sulfates but do not support growth when added to a diet deficient in cystine and methionine. In the present work, several derivatives of cystine were synthesized and administered to rats in a basal diet deficient in cystine and methionine. Cyclic derivatives such as cystine hydantoin and cystine phenyl hydantoin, the sulfonic acid oxidation products of the above hydantoins, a substitution product (dibenzoyl cystine) and a product of partial oxidation of cystine (cystine disulfoxide) were all used. The following results were obtained: Oxidation of the sulfur to the sulfonic acid group entirely inactivates the compound for growth support. Formation of hydantoin rings, with or without oxidation of the sulfur, inactivates the compound. If, in addition, a phenyl group is present, its further toxicity produces still more sharply declining growth curves. Dibenzoyl cystine, being capable of partial hydrolysis in the digestive tract, acts as a partial substitute, while cystine disulfoxide, which is very unstable and readily loses oxygen to form cystine, serves as a satisfactory substitute. This, however, by no means proves that cystine disulfoxide is necessarily an intermediary metabolite of cystine.

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[1] In collaboration with James H. Jones, University of Pennsylvania, and Kathleen C. Andrews.

Studies on the chemical composition and functional significance of mammalian lymph: **Russell L. Holman** (introduced by Wm. deB. MacNider). The following studies were made in an attempt to throw some light on the function of mammalian lymph and lymphoid tissue. Popliteal lymph nodes of dogs when replaced in the popliteal space after complete severance of all vascular and lymphatic connections rapidly undergo massive necrosis. These nodes usually become infected and may slough out. When, however, all vascular connections are severed but one or more efferent and one or more efferent lymphatic channels remain intact, infection does not ensue and the nodes remain viable. Chemical analyses on lymph flowing to and from these "devascularized" nodes show a sharp drop in reducing substance, bound carbon dioxide and carbon dioxide combining power during its passage through the node and indicate that anaerobic glycolysis is one of the metabolic processes taking place in the viable node. These studies were extended to *in vitro* studies in which the nodes were perfused with artificial "lymph" at varying temperatures and pressures, and the rate of glucose disappearance (loss in reducing substance) under these conditions was compared with that of the thyroid gland under similar conditions. Both the flow through the node and the rate of glucose disappearance increased with pressure, and an elevation of 10 degrees in temperature doubled the rate of glucose disappearance. Similar changes were not observed with the thyroid gland. It is suggested that different oxygen requirements are responsible for the differences observed.

Lattice vibrations in polar crystals: **R. H. Lyddane** and **K. F. Herzfeld** (introduced by Wm. deB. MacNider). While the question of the frequencies of vibration of crystals had been the subject of many investigations, there remained certain points for polar crystals which it was felt should be investigated. In the first place, it did not seem at all clear that the frequencies should be independent of the size and shape of the crystal, since the convergence of lattice sums involving Coulomb interactions between ions is notoriously poor. Secondly, the result for very long waves (Reststrahlen) obtained by Born seemed to contradict a result obtained by Herzfeld in an investigation in a different direction. Thirdly, it seemed of interest to obtain some idea of how the frequency spectrum of an actual crystal looked. The main part of the calculation, the finding of the Coulomb force on a particle in the distorted lattice, was accomplished by an extension of the Madelung method. With a reasonable assumption about the repulsive forces between ions, numerical values for the frequencies of a particular crystal (NaCl) were arrived at. It became also clear that the frequencies, for any actual vibration, are really independent of the size and shape of the crystal, and that the results for long waves are explainable.

Radiative loss by electrons with energies up to 2.4 million volts: **Creighton Jones**, **Arthur Ruark** and **Forrest Western** (introduced by Joseph S. Ames). We have studied the radiative loss of energy of electrons which make close collisions with nuclei in a cloud chamber filled with air. Four hundred meters of useful track have been employed. The energy E_0 of the primary electrons lay between 0.4 and 2.4 million electron volts, the average being of the order of one million electron volts. Previous authors found that the cross section for fractional loss greater than 20 per cent. is several times larger than predicted by the Bethe-Heitler formula, which is obtained by the Born approximation. The work of Hulme shows clearly that this approximation gives results which are much too low in the case of large fractional loss. However, in the absence of a more accurate theory we may compare our results and those of Klarmann and Bothe, using Kr and Xe, with the above-mentioned formula. Our results are in better agreement with theory than those of Klarmann and Bothe. (To a good approximation the theoretical result does not depend on atomic number in this energy region.) Several authors have suggested that discrepancies between the experimental and theoretical cross sections for radiation and for scattering require fundamental modifications in the Dirac theory. Others have suggested that such discrepancies are due to non-coulombian interaction between the electron and the nucleus. While such specific interaction may play a part in very close collisions, we believe, in view of the above results, that the main factors in the explanation are simpler and more obvious ones. Even in nitrogen, the chief difficulty in these experiments is multiple scattering in the gas of the chamber. We suggest therefore that the discrepancies are chiefly due (1) to multiple scattering, simulating energy loss; and (2) to the present lack of accurate numerical calculations of the cross section (like those of Jaeger and Hulme, referring exactly to the experimental conditions under which good measurements can be carried out.

An experimental investigation of the rôle of drive in the acquisition and performance of conditioned responses: **Karl Zener** (introduced by Walter R. Miles). In recent explanations of higher mental activities by conditioned response theorists the concept of drive has played a crucial rôle. In all these explanations drive has been treated as an internal stimulus, and the nature and the conditions of establishment of its connection with the conditioned response have been considered as identical with those of any other conditioned stimulus. Certain fundamental assumptions regarding these latter points are common to the more elaborated of current-conditioning theories, but they conflict with the presuppositions of other theories of learning based on the study of presumably more complex behavior. The present set of experiments was designed to test some of the more basic of these assumptions in such a way as to differentiate empirically between the implications of these alternative learning theories. The typical Pavlovian technique was employed. The method involved periods of training for the conditioned responses of salivary secretion to food and to acid in states first of low and then of high hunger; with tests of the responses in both states of hunger during each of the training periods. Variation in hunger affects the conditioned secretions based on food and on acid, as well as the concomitant overt behavior, in radically different ways. The effect of variation in intensity of the conditioned stimulus and of constant stimuli other than hunger was compared with the effect of variations in the hunger drive and was also found to be quite different. An analysis of the difference in the effect of change of hunger upon conditioned and unconditioned secretion is presented. The results are inconsistent with the particular assumptions of traditional conditioning theory which the experiments were designed to test. It is felt that they bear significantly upon the interrelation of the general problems of motivation and learning.

Factorial analysis of learning dynamics in animals: Robert J. Wherry (introduced by Walter R. Miles). The number of forces which have been hypothecated to explain animal learning are extremely numerous, one writer having listed over ninety factors. Certain attempts at correlation analysis, however, have endeavored to show that all errors during learning are in large part due to a single factor present *before* learning begins. Other attempts have tried to prove that another single factor developed *during* learning controls its course. In such studies, the correlations used were between the errors on the first run and the total error scores upon all later runs as a unit. Furthermore, such studies have assumed that the factor or factors involved are of a static nature. In the present study, factorial analyses were made of the learning by animals of maze and discrimination problems. These analyses involved correlations of scores on individual trials and alleys, thus bringing out the rise and wane of different factors. Further research indicated by these preliminary analyses is suggested, and its field of probable usefulness is specified.

Recovery sequence after anesthetization. II. Cyclopropane and nitrous oxide: Albert C. Cornsweet (introduced by C. L. Hull). This is a further study of the behavioral tendencies exhibited by albino rats upon anesthetization. A previous study with ether used as the anesthetizing agent was reported at the 1936 meeting of the American Association for the Advancement of Science. In the present study, cyclopropane and nitrous oxide were used. The animals were subjected to varying amounts of the anesthetics until the animals were in a complete state of quiescence. Upon removal from the anesthetization chamber, the animals were stimulated by means of a tweezers-aesthesiometer, and observations were made as to the temporal sequence of the behavioral patterning. In general, the animals portrayed a sequence of movements, in a fairly definite cephalo-caudad direction. Movements in the head region occurred before those of the caudal extremities. These results coincided with the findings of ether anesthetization. The only consistent difference between ether anesthetization and these gases was that the latter's effect upon recovery was more rapid and telescoped. Of especial importance, however, was the fact that the animals upon going under the anesthetic exhibited caudocephalad behavior movements, a sequence that was the reverse of that of recovery. This fact is contrary to medical theory of anesthetization on human subjects, where the order is, supposedly, cerebrum, spinal cord and medulla. No attempt is made to lay down any definite hypothesis, for much more experimentation remains to be done. Many investigators on pre- and post-natal behavior have tended to emphasize one part of the organism's anatomical, structural and psychological constituents more than another; at times slighting the fact that the animal is a totality, a functional whole, and more than automaton made up of discrete units. Explanations have been too reflexological, rather than in terms of an observable whole. Further work is planned, using other species of life and other types of anesthetics, and perhaps then will a comparative correlation and theory be presented.

SPECIAL ARTICLES

THE SECRETION OF IODINE BY THYROID GLANDS CULTIVATED IN THE LINDBERGH PUMP

The form in which iodine is secreted by the thyroid is not known. The work of some investigators indicates that it is secreted as thyroglobulin. Facts observed by others can not be explained entirely on this basis.

Lunde, Closs and Pedersen[1] *have found* iodine to be present in normal blood in two forms. Part of it is precipitated with the proteins when these are thrown down by alcohol. Part is alcohol-soluble. The fraction that is precipitated by alcohol has been shown to be greatly above normal in the blood of patients suffering from Graves' disease, and to return to normal as the patients improve under treatment.[1] It is also greater than normal in the blood of experimental animals that have been injected with an extract of anterior pituitary.[2] The alcohol-soluble iodine does not vary much from the normal in either case. These findings, together with the fact that positive precipitin tests for thyroglobulin have been obtained in blood as it is leaving the thyroid,[3] indicate that the compound secreted is thyroglobulin. But, if this is so, it is difficult to understand how the thyroid hormone is able to affect the metabolism of all the cells of the body, for thyroglobulin is a highly indiffusible substance. Moreover, Dodds, Lawson and Robertson,[4] on examining the blood of a large number of patients suffering from various types of thyroid disturbance, were unable to find any quantitative relation between the alcohol-insoluble iodine of the blood and the activity of the thyroid as measured by metabolic rate. This suggests the possibility that iodine may be secreted in more than one form.

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[1] G. Lunde, K. Closs and O. C. Pedersen, *Biochem. Zeit.*, 206: 261, 1929.

[2] K. Closs, L. Loeb and E. M. MacKay, *Jour. Biol. Chem.*, 96: 585, 1932.

[3] A. J. Carlson, L. Hektoen and R. Schulhof, *Amer. Jour. Physiol.*, 71: 548, 1925.

[4] E. C. Dodds, W. Lawson and J. D. Robertson, *Lancet*, 2: 608, 1932.

To obtain further light on this subject, 20 cat and 8 rabbit thyroids were cultivated in the Lindbergh perfusion pump.[5] Then the media in which they were cultivated were fractionated and the various fractions analyzed for iodine.[6] The globulins were precipitated with ammonium sulfate, and the total protein fraction with alcohol. Control fluids were saved in each case and analyzed in the same manner as the perfusion fluids so as to correct for the iodine present in the medium before cultivation. Serum at 40 per cent. concentration in Tyrode's solution was used as the medium in most instances, though 20 and 80 per cent. serum were also tried. The perfusion time was varied from 4 hours to 6 days.

In every instance iodine that was set free by the gland was found in the medium in two forms. Part of it was precipitated with the globulins, and part was found in the globulin-free filtrate. Part was likewise found in the alcoholic precipitate and part in the alcoholic filtrate. The amount that was precipitated from any one medium was the same no matter which precipitant was used. And the sum of that recovered in the precipitate and that found in the filtrate was the same as that found in the unfractionated medium. Thus, gland No. 289 set free 25.2 gammas of iodine. 9.7 gammas of this was found in the precipitate, and 15.6 gammas in the filtrate. As is seen in this example, the iodine that is recovered in the filtrate is no small part of the total secreted. In some experiments it amounted to as much as 80 per cent. of the total, and as much as 40 per cent. of that originally present in the gland.

Presumably, the iodine that is found in the globulin fraction of the medium is contained in thyroglobulin or slightly modified thyroglobulin. That recovered in the filtrate is probably contained in hydrolytic products of the thyroglobulin molecule. It can not be derived from inorganic iodine stored within the gland, for the glands do not contain any such quantity of inorganic iodine. To make certain that this was the case, a number of uncultivated thyroids were fractionated and analyzed. The non-globulin iodine of the glands was found to vary with the total iodine content and constituted only 10 per cent. of the total. That found in the filtrate was often as much as 40 per cent. of the total.

Because iodine appears in the medium in two forms it is not necessary to conclude that it is actually secreted in two forms. It is conceivable that thyroglobulin might be secreted and hydrolyzed later as cultivation is continued. And, as a matter of fact, a larger portion of the secreted iodine was found in the filtrate in experiments in which the glands were cultivated for 6 days than in those in which they were cultivated for only one day. Yet, when thyroglobulin extracted from cat thyroids was incubated with 40 per cent. serum for two weeks at the various pH values which exist during cultivation no hydrolysis occurred. Apparently, therefore, thyroglobulin is broken down only when the gland is present. To avoid changes that might occur after secretion had taken place experiments of very short duration were made. But whenever any measurable amount of iodine was secreted a part of it was always found in the filtrate. And, when thyreotropic hormone was added to the medium to stimulate secretion, more of the iodine secreted as the result of adding the hormone was recovered in the filtrate than was found in the precipitate. These facts seem to indicate that the iodine is actually secreted in two forms. The increased proportion found in the filtrates in long-continued experiments indicates that the gland continues to act on thyroglobulin that has been secreted as it is repeatedly returned to the gland in the circulating medium.

But if the thyroid secretes iodine in more than one form when it is cultivated outside the body, why has no evidence of such activity been obtained within the animal organism? There is, of course, the possibility that the gland functions differently *in vitro* than it does *in vivo*, and that glands of different animal species function differently. But the most plausible explanation seems to be that the smaller fragments of the thyroglobulin molecule, being more diffusible than thyroglobulin itself, are quickly absorbed by the various cells and tissues within the body and so do not remain in the blood stream.

To summarize: Iodine set free by the thyroid gland during its cultivation in the Lindbergh pump is recovered in the medium in two forms. Part of it is precipitated with the globulins of the medium, and part is found in the globulin-free and also in the protein-free filtrate. Evidence is given which indicates that the latter is contained in degradation products of the thyroglobulin molecule formed as the result of activity of the gland.[7]

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[5] C. A. Lindbergh, *Jour. Exp. Med.*, 62: 409, 1935; A. Carrel, *Jour. Exp. Med.*, 65: 515, 1937.

[6] The method used was a modification of that described by V. Trevorrow and G. J. Fashena, *Jour. Biol. Chem.*, 110: 29, 1935, and 114: 351, 1936.

[7] Thanks are due Dr. Carrel and several of the members of his technical staff for cultivating the glands, and assistance in other parts of the work.

PHOTOGRAPHIC NATURE OF TANNING OF THE HUMAN SKIN AS SHOWN BY STUDIES OF MALE HORMONE THERAPY[1]

THIS condition of the skin is known to be influenced by the endocrine system, as for examples, the bronzing in Addison's disease of the cortex of the adrenal gland, the acne commonly associated with puberty and the pigmentation changes during pregnancy. Changes in the skin of a hypogonadal patient following the use of synthetic male sex substance testosterone propionate[2] have been reported.[3] A further series of three surgically castrated[4] and four hypogonadal males has been studied. Before treatment the skin in all but two cases was of a characteristic pasty, sallow color, gray and lacking in pink tinge. This was most pronounced in the castrated men. After treatment with testosterone propionate there was a rapid flushing, followed by increased oiliness of the skin and growth of hair on the face, chest, abdomen, arms and legs. All patients presented a more tanned appearance, particularly of the face, neck, hands and exposed parts of the skin. Part of this increased pigmentation is due to "developing" of pigment from previous exposure as indicated by the following history:

Case 1. Orchidectomy was performed in May of 1937, after which time the patient tanned but poorly and burned easily upon exposure to the sun. In August of 1937 he spent part of every morning and afternoon for a week lying on the beach clad in an abbreviated bathing suit of a peculiar cut. Only slight coloration resulted. The patient was examined by the authors several times during December and January, at which time the body skin was of a pasty sallow color. Treatment with male hormone substance was begun in the dead of winter, January 17, 1938. Within three weeks there appeared, along with the bronzing of the face, a tanning of the body save where it had been protected by a bathing suit. The patient had not worn the bathing suit, whose peculiar pattern the tan fitted, or any other bathing suit for five months. Neither had he sunned himself or used a sun-lamp in similar fashion.

Upon withdrawal of the hormone treatment in February of 1938 the flush disappeared from the skin and the tanned areas gradually faded. Subsequent injection and withdrawal periods induced, respectively, coloration and a fading of these areas which had not been exposed to sunlight since the previous August. These phenomena might be accounted for in part by assuming either that tanning consists of a continued production of pigment over a long period of time or that the melanin becomes colorless unless an adequate hormone supply be present.

Graded exposures to a sun-lamp have been given to this and to other patients and a similar series of pigmentation changes have been observed during periods of treatment and withdrawal.

From studies of men with low amounts of testicular secretion it appears that male hormone substance exerts a "developing" action upon the rather colorless material which is laid down in the skin following exposure to the sun or sun-lamp. This "developing" action may be exerted as late as five months after exposure. This indicates that tanning may be a "photographic-like process" of "exposure" and "development," with the sex hormone acting to "develop" color-lacking material laid down in the skin by exposure. Further, the pigmentation is not established continuously but will fade upon cessation of hormone treatment and reappear upon later resumption of treatment.

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ACTION OF VANADIUM ON TISSUE OXIDATIONS

IF 10–20γ of vanadium in the form of sodium meta vanadate is added to rat or guinea pig liver suspension at pH 6.7 a large extra oxygen uptake occurs. This effect is much less in kidney and absent in brain. Concentration curves indicated that some substance in the liver was oxidized in the presence of vanadium. To prove this the following experiment was done. Rat liver was ground with buffer pH 6.7, squeezed through muslin and centrifuged. The solid was resuspended in 40 cc of water to which 10 cc buffer pH 6.7 was added and centrifuged again. This process was repeated four times and the resultant solid material which was free of hemoglobin and light yellow in color was finally suspended in 15 cc buffer pH 6.7. This constituted the enzyme preparation. The substrate was prepared as follows. A guinea pig liver was chopped and ground in buffer pH 6.7. Enough alcohol was added to make the final concentration 70 per cent. The precipitate was filtered and the alcohol evaporated off in vacuo at 40° C. The resulting suspension was extracted with ether three times, leaving a clear light yellow solution This solution was then treated with a small amount of Lloyd s reagent and filtered The filtrate was now almost colorless It could now be evaporated down to dryness and extracted with boiling 95 per cent alcohol The alcohol extracts the substrate, which is redissolved in water after the alcohol is evaporated off. Table 1 gives the oxygen uptake in c.mm. of the various combinations of enzyme, substrate and vanadium after half an hour at pH 6.7 and 37° C. 0.5 cc enzyme suspension and about 10 per cent. of the amount of substrate present in one guinea pig liver was used in a total volume of 2.0 cc in the Warburg vessels.

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[1] Supported in part by the International Cancer Research Foundation.

[2] Furnished by the Ciba Company under the trade-name Perandren.

[3] James B. Hamilton, *Endocrinology* 21: 649 1937

[4] Neal E. Miller, Gilbert Hubert and J B Hamilton, *Proc. Soc. Exp. Biol and Med.*, 38 536 1938.

TABLE 1

	O_2 uptake c.mm.
Enzyme	0
Enzyme + vanadate	0
Vanadate + substrate	0
Enzyme + substrate	12
Enzyme + vanadate + substrate	119

Work on the chemical identification of the substrate is now proceeding. Experiments have shown that it is probably not an amino acid, amine, simple alcohol or aldehyde, purine, low fatty acid, choline, succinate, cholic acid, citrate, lactate, pyruvate, glucose or ascorbic acid. It is probably a phospholipid.

As vanadium is found in small traces in all tissues these results raise the question whether it has a normal catalytic function in the body and whether it is an essential element.

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A COMPARATIVE STUDY OF THE SUBTERRANEAN MEMBERS OF THREE FIELD GRASSES

A COMPARATIVE study was made of the roots and root hairs in upper soil levels for oats, winter-rye and Kentucky bluegrass. Soil samples 3 inches in diameter and 6 inches deep (42 cubic inches) were taken from the fields by means of a cutting tube, and measurements made of the included subterranean plant parts. Total lengths of both roots and root hairs were used in computing the extent and surface exposed by the underground members. In Tables 1 and 2 the values given are the average of the three soil samples surveyed for each species.

TABLE 1
ROOTS*

	Total number of roots	Total length of roots (ft.)	Total root surface (sq. in.)
Oats	4,700	150	50
Rye	6,400	210	78
Bluegrass	84,500	1,260	330

* Per soil sample (42 cubic inches).

In a comparison of the cultivated rye plants grown in competition with a non-competing greenhouse rye plant, previously surveyed,[1] it was found that the field rye had approximately 5 times the number of root hairs per unit of root length as the non-competing greenhouse plant. However, the indoor plant had far more and longer roots, and consequently a greater total number of root hairs.

TABLE 2
ROOT HAIRS*

	Total number of root hairs (in millions)	Total length of root hairs (miles)	Total root hair surface (sq. ft.)
Oats	6.3	4.9	3.7
Rye	12.5	10.0	8.2
Bluegrass	51.6	32.0	16.9

* Per soil sample (42 cubic inches).

Assuming that roots and root hairs were evenly distributed throughout the samples, one cubic inch of soil from this oats field would have approximately 110 roots and 150,000 root hairs, with a combined length of about 630 feet and a surface area of 15 square inches. A similar cube of soil from a field of winter rye would have approximately 150 roots and 300,000 root hairs with a combined length of 1,300 feet and a surface of about 30 square inches. Kentucky bluegrass would have, per cubic inch of soil, approximately 2,000 roots and 1,000,000 root hairs, with a combined length of over 4,000 feet and a surface area of about 65 square inches. When it is considered that these grasses have from 150,000 to 1,000,000 root hairs per cubic inch of soil their importance in the physics of the soil is obvious. From the standpoint of their usefulness as soil binders oats would be least efficient, rye intermediate and bluegrass far superior to either of the others in retarding erosion.

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[1] H. J. Dittmer, *Am. Jour. Bot.*, 24: 417–420, 1937.

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NATURE AND THE DOCTOR[1]

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EVERY good doctor is a naturalist, and there is none more whole-souled or with a larger task. It is no accident that so many medical students have ranged through the fields as boys for rocks or plants, or that John Hunter while at the zenith of his London practice took time to inquire into the structure and economy of whales. To be an ardent observer seems the best of qualifications for the study of medicine. That it is not, though it is the first.

The doctor has always deemed himself eager to listen to Nature and to carry out her commands Her name has been as often on his lips as that of Liberty on those of the social philosophers Always he has spoken of aiding her of not offending her, of letting her take her course (as if she would not take it anyhow by hook or crook), and time and again he has invoked the *vis medicatrix naturae*, conceding that "Nature is the best physician," an admission not the less wise because the fact has so often been staringly evident. Yet with all said it remains true that his relations with Nature have not been continually happy. In the great Oxford Dictionary, under head four, subhead eleven, section C of the meanings given for the word "nature," one finds the following: "Nature—contrasted with medical skill or treatment in the cure of wounds or disease." When first read this seems an innocent and even an encouraging usage; for it stresses the surgeon's success in changing the natural course of events in acute appendicitis, and the physician's in diabetes or pernicious anemia. One becomes for the moment complacent. And then, reading on, one notes just below in the dictionary, under section D, a companion statement, "Nature—contrasted with art," and there come to mind certain recent forms of art which seem expressive of a lively disagreement with nature. Then one thinks of the history of the medical past—of the many centuries during which the phenomena of disease were hid almost wholly away from the doctor, of his ignorance, opinionation and well-intentioned rashness during that time, of the reticence, obstinacy and conservatism which Nature still shows; and one becomes uncertain about the present. Can it be possible that in the statement, "Nature—as contrasted with medical skill or treatment," the doctor of to-day is not merely involved but in some degree reproached? How does his relationship with Nature really stand? Is he actually at odds with her on some points?

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[1] Convocation address at the Medical School of the University of Michigan, October 1, 1938

The three tasks set every human creature, to see, to know and to do, are notably difficult in the case of the physician: he has to perceive disease phenomena, to understand them, and to cure or at least make them tolerable, preventing future instances. The difficulty with this task has been that sick and well alike have forced the doctor to act before he could know, and to assume, for practical purposes, that he knew before it was possible for him to perceive. Furthermore, he has had to be infallible: error could have no place in the reckoning. A horrid fix this for any reasonable man, and none would have let himself in for it except for the dire situation of his fellows. Throughout countless years people all about the doctor have cried to him, "Why don't you do something?", and disease has cried even louder. He has had to do it, to do his ignorant and erring best. This is still his situation as concerns not a few ills. Each case of paralysis agitans, every inoperable cancer that he sees goads him toward action. He must still treat the insane without knowing why they are so. Yet now at last he has to a large extent worked things around into their proper order; and what is even more important, he sees where next to direct his energies and how to bring them to bear.

This happy state of affairs is essentially recent, and it is due far less to the age-long heaping up of knowledge than to the modern approach to the unknown. Who was it said that discovery results from chance and the prepared mind? The prepared mind of nowadays makes its own chances. It is not content with what comes its way but devises occasions, goes out to find worlds of which there may be no token. So it is that the doctor sets forth to discover. He has become a passionately enterprising observer. He invents instruments and technics with complete assurance that they will disclose things worth while, though he may not know what. Knowledge has come to him in the past mostly through experimentation—which began with the first dose ever given to a sick man: and now he is determined to make the experimental method yield everything that is in it. This decision is not peculiar to him: as you well know, a furor for experimentation has seized of late upon all thinking humanity. It has been applied even to the most delicate and lovely of human relationships, not within casualties at times, as one may remark in passing. But the sick man is not the worse because of the expansion of the doctor's inquiries; curiously enough, the patient is less experimented upon than ever before. When all was ignorance, all inevitably was random experimentation or rule of thumb in coping with disease. But in proportion as the doctor has got to know more and more of the human body he no longer makes shift in these ways but resorts to purposeful moves. Furthermore, as an experimenter he has found that the major laws which rule in the body of animals rule with a striking particularity in the human organism as well; and from the study of diseased lower creatures he has learned about man.

The sick have always had more signs and symptoms standing plain to view than the doctor was able to note, even when he had only the outside of the human creature to scrutinize. One might think that the ancient physicians, Greek, Arabic, those of medieval Europe, possessed of no instruments, other than their own senses, wherewith to perceive, would have covered the narrow field accessible to them, that they would have noted and described and categorized all that unaided man could see or hear or smell of common illness. There were those of course who thought that they did so; but we realize that they fell short and that not even now has this limited task been completed. For generations doctors have been schooled more earnestly in observation than any other large group of men. Circumstances teach it as a skill to poker-players, horse-traders and politicians; poets are born with it; but medical students are drilled in it, and innumerable occasions drill the physician. Nevertheless, as you and I know, an acute doctor can still discern new signs and symptoms in diseases long held wholly familiar. It was only yesterday in medical time that those little spots on the inside of the mouth were pointed out, which help so much in the recognition of measles. And when it comes to a comprehension of the workings of the normal mind how little do we apprehend of what any one with a good brain of his own might find out! It has always been to man's interest that he should realize not only what other people were thinking but what went on in his own head—that he should understand human nature as it is called. Time and again people have solemnly counselled one another, "Know thyself!" Yet of late it has become plain that even the doctor has perceived but a small part of the mental workings of healthy man, let alone those of the sick, and that there are reaches of thought far beyond its immediate spectrum. One might have supposed that some of those subtle individuals existing in all ages, to whom guile has been a pastime and thinking a diversion, would have discovered these reaches and made them familiar. The opportunities were there and the technical means, namely sharp and capable mentalities. Nevertheless, the Greeks had no word for personality, much less for introvert.

Such examples stress the need for a frontal attack on the unknown. This now seems so inevitable that one wonders why it was not undertaken many centuries ago. The impediment lay in the second of the doctor's tasks, that of interpreting what he saw. Observing seems less necessary when all is sufficiently explained: and what one sees looks different in the light of explanations. The old doctor had to have these if he was to attempt cure in any rational way, and to be rational was his first need because the unknown loomed so huge. Only his reason could keep him from falling into confusion and fear. His situation was abominable. He had to try to understand for practical purposes what was happening in an organism whose feet swelled or whose arm pained when the trouble really lay in the heart, and who felt strange thrills in the heart when sexually attracted to the female. He did not know what all this meant, but he could think about it and think he did with every wit. He saw the same trains of events occurring again and again, with death or health or incapacity as their outcome; and he made up explanations which were so satisfying that they had to be true. He propounded "systems" of medicine (text-books still flaunt the term) which were so beautifully imagined that they made further search for the causes of disease an impertinence. The three humors explained all, or the four elements, or an Archaeus which sat in the stomach and issued orders to the other organs.

This effort to explain phenomena before they were fully perceived was not unique with the doctor, though his needs led him to push it to an extreme. It has been the bane of discovery in every field all along. While man is a curious animal the vice of his curiosity is the ease with which it can be satisfied. He can only feel comfortable when things have been reasoned out; and insisting upon an explanation he becomes its immediate victim. Samuel Butler asserted that man really does not wish to know, that all he desires is tranquility of mind, or, as Butler wickedly put it, to have "the peace that passeth understanding." Certainly explanations have always gone far to content doctor, patient and patient's friends. They went very far indeed when one could perceive nothing of what went on beneath the skin during life and seldom looked under it after death. There were not enough facts then to keep ideas in their place.

This is not an effort to disparage the past but to understand it, as bearing upon the present. It had its great medical discoverers, as modern in their point of view, as clear-sighted, as any of to-day. Their names are too many to tell over. But these men changed material situations far more than they did the general attitude as affecting discovery.

The old doctor, then, had not only to cope with the unknown but with his preconceptions concerning it. These acted to keep him from seeing straight, from hearing clear. How far they could mar his perceptions can be judged from a trivial incident of to-day. A man engaged for many years in medical research, and hence accustomed to observing, bought a player piano of the sort that gives out sound in proportion to how hard one works at pumping it. The salesman showed him a lever and told which way to push it for the music to swell loud or grow faint. For many months he thrust that lever in the wrong directions, toward loud when he wanted faint and *vice versa*, never discovering his error but at length informed of it by a tuner. True, he had managed to compensate for his mistake in some degree by pumping strongly for loud music and mildly for soft. But the worst of the whole thing was that, when finally told, he hated to have to readjust his method to the truth. He had become so accustomed to doing the wrong thing well that it satisfied him. One can see how an early American doctor, deft in the art of bleeding, making of it a technical as well as an intellectual rite, would have overlooked the damage it caused and have clung to its use.

If preconceptions hampered observation, they hamstrung inference. Now we try to be dissatisfied with explanations for phenomena not wholly understood: but are we always successful? Certainly to the medical student that text-book still seems most worth while which explains best. And he admires those instructors who appear bright and sure in their replies, detesting such as wander uncertainly through the laboratory, qualifying their answer to every question, and obviously oppressed with what they do not know. The student sees knowledge as exquisitely sharp and clear because his instructors have not had time to dwell upon its blurred outlines and nuances. Consequently, the questions sometimes asked in eager good faith by his own family, whether to wear a ring against rheumatism, or carry a horsechestnut in the pocket to ward off asthma, seem profane, almost obscene. They may provoke him to be frantically dogmatic and render him medically useless in his own home.

This confidence that knowledge is precise can not last more than a year or two; it is shaken out and away by the facts that buffet the young practitioner from every side. As he goes on with his life he sees the impossible prove real so often that he becomes a humble as well as an ardent observer. The discovery of the Roentgen rays may be said to have ushered in a medical era characterized by increasing surprise and humility. It is difficult to realize that only a generation ago men deemed cod liver oil a household remedy perpetuated by superstition, and doubted whether sunlight had any virtue beyond the psychical. They then thought of foods wholly in terms of fats, carbohydrates and proteins, mentioning salts, condiments and spices merely *for completeness sake*, since there were no calories in them and calories were what counted. In that confident period the doctor had suddenly learned so much through his own efforts that he had become mind-proud. Now the empirical good has once again made its weight *felt*: and we are again prepared to take hints from the past experience of the race on how to maintain health, and to assume that there may be reason in them, though we know it not. The doctor looks eagerly and profitably into quaint notions, as for example that maggots may help in osteomyelitis by devouring the dead bone.

In those Dark Ages of medicine when thinking made things so, there were immense opportunities for the wrong sorts of men, those who were not naturalists, but who had the endowment of visionaries, oftentimes religious. The desire to do good is a magnificent reason for wishing to become a doctor, but unfortunately it is no sign of fitness. Certainly one would not care to have a great poet or artist as one's physician, no matter how much he knew. For what these see they transmute. A little poet, a minor artist, those who draw their main strength from the sensitive perception of realities, yes, they will do better than well in coping with disease: and there have been many such amongst good physicians. But the visionary is an unnaturalist: as a doctor he runs amuck. He becomes the most dangerous and effective of all quacks, limpidly sincere and often lovable as a person, carrying his fellow mystics along with him joyfully, and dominating ignorant folk through the vigor of his convictions. In the old days the honest mystic had every chance to do the harm of his beliefs. Now he stifles in the atmosphere of medicine, its facts harry him, and he seeks the wide air of occupations in which there are more unconsidered variables.

How has this come about? It has come through the demonstration that this disease and that, more and more of them with every year, are entities as real as so many pebbles; and that the happenings for which they are responsible within the body are not nearly so haphazard as the rolling of pebbles downhill in response to physical laws. No need to remark to this audience that when one looks into the dead the wonder is in many cases that they lived, so gross has been the damage to organs and so arrant the interference with function. The efforts of the organism to survive are writ just as plain. For the body does not bear injuries meekly; it has not renounced or been absolved from a single law because it can not keep its temperature normal or digest its food. Though men term it disordered, order still prevails in it, though of a different sort. It has recourse to every possible stratagem of functional readjustment and repair, compounds felonies, fights rearguard actions to the last; and the marks of old lesions often disclose unbelievable victories. Walt Whitman could have sung a grander hymn to the body if he had seen all this. The best of the matter from the doctor's standpoint is that what he now perceives of bodily recourses and reactions he realizes to be inherently understandable, though it *may not as yet* be understood. When at last he lays bare an ill it does not prove to be a morass of the unknowable. Nature's activities have not become more mysterious on close scrutiny: they have but become more vast.

Nevertheless, as you well know, misbegotten, *a priori* philosophies explaining all of disease and all its cure are still rife in civilized communities. But now doctors as a class go free of them. It is the laity amongst whom they make play. Yet a clever new thought affecting the interpretation or treatment of disease will always take strong hold on the doctor. Anybody who scans that microcosm, the *J.A.M.A.*, for the last 30 years can follow the rise and fall of many an alluring idea. It spreads swift as a contagion, is acclaimed, utilized everywhere, but at long last begins a lingering disappearance from the literature. Where are the opsonic index, the ninhydrin reaction of yester year? The clever idea spreads so fast not only because of the urgency of human need, though this is the prime reason, but because doctors are still school men in some degree, easily governed by ingenious thoughts, rising with enthusiasm to notions that are attractive, and loving to think and work and discuss in company. The ill-founded concept is relinquished slowly, not alone because there may be nothing wherewith to replace it, but because doctors are loathe to believe that such an excellent conceit should not be Nature's as well as their own.

Though the doctor can no longer be a metaphysician, much less a mystic, in his interpretation of disease processes, he yet must recognize the force of the mystical point of view. While mystics do not have a different sort of measles, yet asthma is no less real because provoked by the sight of an artificial rose. According to Mr. Dooley, who, as some will remember, held forth at the time when our soldiers were dying of typhoid by the thousand during the war with Spain, "The man who taught us to boil our drinking water did a dom sight more for us than the feller who said 'Hitch your wagon to a star.'" The worst of this beguiling philosophy is its pragmatic appeal, as no one sees more clearly than the doctor, who made the discovery that in those days drinking water had to be boiled. He knows that the potential influence of the mind over the body has been no whit diminished by the discoveries which have reduced a large part of what used to be deemed spirit to rather deplorable flesh. It is even his ambition to make the mind influence the body more than it ever has, and in ways productive of good; indeed, he already does this in certain risky yet rewarding combinations of medicine with inspiration. He knows that the mystic has a place and a power in human affairs, that he constitutes a saving opposition to received ideas, leavens the human lump. Yet he realizes also that the mystic can not be a wise physician.

The third of the doctor's tasks, that of setting things right, is the only one that the laity really care about. Here is where in all ages there has been the physical devil to pay whenever idea has prevailed over fact. Too often the physician of the past has been unable to see that his triumph of mind over matter was an empty one. Just recall in this connection Hawthorne's story, "The Birthmark," written less than a century ago in commentary on his own times, which tells of the young doctor trying to remove the naevus from his wife's face, who watched it pale and disappear, never noting that as it did so his wife died. The efforts determined by philosophies of medicine were in many cases far worse than aimless: misdirected, they had back of them all the force of beliefs strongly held.

Such was the state of affairs for hundreds of years up shockingly close to the present. During this time the well-educated European doctor was often a St. Thomas Aquinas of the body. But you will recall that St. Thomas and the other school men, whose task it was to reconcile logic and theology, had to let logic go whenever there was conflict. The doctor was under no such compulsion. When his logic was contradicted by happenings within the patient, the latter often bore the brunt of the decision.

There was of course a fairer side to the picture In every time there have been men, like Paré, who looked with clear, shrewd eyes upon illness, were adroit in doing the possible, and for the rest stayed their hands.

Even when the old doctor was not empowered by rationalization, when they had not made of him a doctrinaire, there yet existed a strong reason why he should persist in a way of treatment that appeared to do harm. This reason, well understood by him, was that no single patient could possibly serve as the touchstone of his methods, owing to the diversity of human illness and of man's constitution. Hence he wrote off bad consequences, disregarded demonstrations against him by the individual sick body. Facts may force people to their knees, but they get up again when they have an idea. Of no one has this been more true than of the doctor. Take Benjamin Rush, for example, a hard-headed, sensible man. He was at his wit's end to treat yellow fever in Philadelphia in 1793, when he found one night, while searching for what had been done previously, that a Scotch physician had thought violent purgation to be effective in the Virginia epidemic of 1743, and furthermore had advised against "an ill-timed scrupulousness about the weakness of the body." Thenceforth Rush purged and bled with all the energy of a courageous and devoted character. So doing he gave impetus to the American school of bleeders, and they continued to take toll until far into the next century. Like all pledged to "systems" of treatment or medical philosophies, they suffered much for conscience sake and led uneasy, contentious lives. Believing that they alone could be right they fiercely detested efforts of other sort at cure. Rush was not on speaking terms with Dr. Adam Kuhn, the grave German physician who alternated with him in the treatment of the Drinker family.

There was the more reason for the old doctor to hold fast to his ideas, because both his ignorance and the public forced upon him the rôle of seer. The sick have always thought of doctors not as they are but as they would wish them to be. They place trust, they are not prepared to excuse. For sickness becomes a double burden when the doctor seems as likely to make mistakes as all the other people that you and I know. He has accepted this reliance upon him as implicit in his situation, and the result has been, not an absurdity but a relationship fine in human values The truth is that the doctor has had to be self-confident to gain best results. Emerson wrote in his journal in 1837: "The same complaint I have heard is made against the Boston Medical College as against the Cambridge Divinity School, that those who receive their education want faith, and so are not as successful as practitioners from the country schools who believe in the power of medicine." Yet this faith has not always worked for fresh discovery as concerns disease The gold-headed cane of the eighteenth century doctor, his dignity, the ritual formality of his visits to the sick room, though aiding the patient's state of mind, often trapped him into thinking too well of his own abilities and fenced him in this way from nature. The parade of efficiency in the modern hospital, its cool and silent whiteness, its swiftness in action, the deference to the chief on "rounds," the whole arresting contrast with the outside world, mean more than a task undertaken with the ailing body, and release for the patient from responsibility for himself—they imply that things will actually be done with more understanding and more surely than in any other sphere of human effort. But while in this way they help the sick, to no negligible extent they bring risk to the doctor. Their effect on him might be very damaging were it not warded off by the disclosures of the clinical laboratory, the x-ray department, the postmortem room, which keep him chastened and effective.

In the old days thought on how to undertake curing took the same two lines as to-day: One could either give natural processes their head and urge them on, or mix in and try to direct events. These alternatives were frequent in ancient story. The heroine, coming upon the hero wounded and alone in the forest, dressed his wound with simples and gave him cooling drinks. He got well. The other literary recourse was more complex. He did not get well, so the heroine had him transported by litter to a leech who administered a draught of such potency that sometimes he had a major convulsion, and in any event passed into a trance from which several days later he woke up cured, and often with a far more agreeable personality. What the doctor gave had shaken things at their foundations, had averted chaos.

There was reason in the leech's violence if not sound reason; and it was the outcome of earnest observation. To the ignorant watcher disease and death seemed to have little of that order which reigns in the healthy body. The doctor saw what appeared to be a falling away from standards, a dissolution in progress that was far along before the organism gasped its last. Nature seemed incapable, all was disordered. These words dissolution, disorder, clearly express what the doctor believed that he witnessed and they give his interpretation of it. Serious illness was often the more appalling because it seemed a muddle. What more reasonable then than to try to restore order by drastic means? Out of such thinking came the dogma that violent diseases demand strong remedies. And thence, in some part also, that perturbing contrast to be found in the dictionary of to-day between nature and medical skill or treatment.

Now we no longer see disease as disorder, though the term still holds place as a synonym. We perceive that no matter how abnormal a body state may be, it is still natural. To the scientist, even the iridescence of decay, the scum on the pool, are the expression of laws which might be termed wholesome if the word had any meaning in such connection. And with the extension of this view to the laity has come a vast relief. For sickness was indeed appalling when it seemed to come out of nowhere and to be obedient to nothing. The special horror of the pestilences was that they walked in darkness. This horror is felt still in relation to a few diseases, notably cancer, but even in these the doctor can perceive laws. To the public yellow fever is now only a virus disease transmitted by mosquitoes, and the plague a bacterial infection. Such knowledge would be fortifying, even if they came again. And understanding has brought with it a common-sense attitude. The campaign against the venereal diseases can be so free-spoken because their causes are matters of fact.

The doctor himself has become the complete realist that he has always wanted to be. Facts are his familiars and mould his thought. He perceives that while he can hurry Nature or impede her, humor her, help her or narrow her field of activities (as when the surgeon takes out an organ), he can not change her ways, much less flout them. Patiently achieved in the course of long time, they will not soon be let go. But he sees too that in many respects he is already wiser than the body, which works from precedent to age-old precedent, and when confronted with crises resorts to the same immemorial gambits. Frequently now he can go Nature one better in healing the sick through exploitation of the resources that she provides, as for example the hormones. He still cures in many ways that he does not understand, but now he begins to feel a slight humiliation when so doing. In his primary task of observation he is more than ever behind. Despite all his instruments he is still hampered by sheer inability to perceive, while furthermore the scope of the perceptible has broadened incredibly. It provides one of the greatest of present dangers to the doctor's relations with Nature. So much of detail there is for him to look upon and realize as to bring risk that at times he may not see the organism as a whole. Yet this is his culminating duty. The wisest physicians will always be general practitioners in the sense that they deal in thought with the whole case.

In the eighteenth century the activities of the doctor as a field naturalist sometimes brought great discovery. Withering was the very man to have been told that a "wise woman" in a nearby village cured dropsy with a decoction of herbs. There were more than twenty of them in the mixture, yet, as he remarked, the problem presented no difficulties "to one conversant in these subjects"; the fox-glove, the digitalis, was the essential ingredient. For Withering knew botany, and had already produced a compendium of British plants that was to be used for generations after him. Jenner did not have a casual chat with a milkmaid and then take a fling at vaccination. Living in the country and keen about animals of all sorts, his observations convinced him that cow-pox and the "grease" in horses represented smallpox in an innocuous form; and after his first successful inoculation he waited nine years, rejecting material after animal material, before he got one that seemed right in his experienced view. With it he made the test which justified publication.

Now as field naturalists we roam chiefly within the body. Bacteriology has supplanted botany; and the habits of organs seem more important than those of animals. Cushny remarked as long ago as 1915 that all the great therapeutic discoveries of the preceding 50 years had stemmed from the laboratory. Nevertheless medical science now derives strength more than ever from the study of life in the lower forms. It is not merely that cows have tuberculosis and pigs influenza. There exists a physiological kinship amongst organisms of the most incongruous kinds. The realization that Nature does not conform with man's meager imaginings but far exceeds them has always been one of the chief delights of the investigator. Could common sense have prophesied that observations on certain cells wandering within the negligible body of a skipping little crustacean, a waterflea, would tell how bacteria can be met and destroyed when they invade the human being? To find out anything from tobacco plants that will apply to human virus diseases seems a wild thought. Yet one can and does. It has dawned upon us, somewhat more than dawned, that the happenings in animals and plants have far greater meaning for us than their forms would imply. These overemphasize the differences in a most deceptive way; for living creatures are joined by their functional principles into a sort of vertical union. The same insulin that works in the cod-fish will save a diabetic man. What takes place within animals and plants is our own vital concern; no natural science but is in some sense our province. And the further the doctor peers amongst organic phenomena the more twos and twos can he see ready to be added up into fours.

Nothing in medicine has bettered so much throughout the years as the doctor's relations with Nature. Now he is more of a naturalist than ever. It may be urged that the change has been quantitative, that Hippocrates would find himself on easy terms with the good physician of to-day. Granted. Yet there are alterations which, though intrinsically quantitative, are qualitative in effect: they make the world look different. And the world of the body looks different now to the doctor, though it is only himself that has changed.

OBITUARY

IN MEMORY OF OTTO HILGARD TITTMANN

At a meeting of the Board of Trustees of the National Geographic Society held on October 27, the following resolution was adopted on the death of Dr. Otto Hilgard Tittmann, one of the founders of the society and its president from 1915 to 1920:

> With profound sorrow, the Board of Trustees of the National Geographic Society records the death on August 21, 1938, of Dr. Otto Hilgard Tittmann, a founder member of The Society.
>
> A member of the Board since 1888, and President of The Society from 1915 to 1920, Dr. Tittmann had an important part in building The Society from a small group of pioneers to the world-wide organization of to-day. His keen scientific mind, his administrative ability, and his loyalty to The Society are recognized by this Board as vital factors in The Society's fifty years of progress.
>
> Dr. Tittmann was an outstanding geodesist of his day. At seventeen years of age, in 1867, he began his scientific career as a member of field parties of the Coast and Geodetic Survey studying the Atlantic and Gulf Coasts. His frequent elevation to higher posts of responsibility in the Survey and his excellent work on special scientific assignments by his Government in the fields of geodesy and astronomy finally won for him, in 1900, the appointment of Superintendent of the Coast and Geodetic Survey.
>
> At the early age of twenty-four years, he was assigned as assistant astronomer of an expedition to Japan to observe the transit of Venus. On his return to this country he continued his field work on the Atlantic and Pacific Coasts, and in 1887 was appointed Chief of the Office of Standard Weights and Measures, then a part of the office of the Coast and Geodetic Survey.
>
> Outstanding among his achievements was his work in connection with the marking of boundaries between the United States and Canada and Alaska and Canada which covered the period from 1893 to 1911, and his researches in the field of geodesy.
>
> In recognition of the valuable contributions of Dr. Tittmann to the National Geographic Society, of his important scientific achievements, of his inspiring leadership, be it resolved that this expression be spread upon the minutes of The Society and that a copy be transmitted to his family.

RECENT DEATHS AND MEMORIALS

Dr. Edwin Herbert Hall, professor emeritus of physics at Harvard University, died on November 20 at the age of eighty-three years.

Dr. John C. Phillips, research curator of birds in the Museum of Comparative Zoology of Harvard University, member of the faculty of the Peabody Museum of Harvard College and president of the Peabody Museum at Salem, Mass., died suddenly while shooting in the woods of New Hampshire on November 14. He was sixty-two years old.

Dr. Howard A. McCordock, professor of pathology at Washington University School of Medicine, known for his work on sleeping sickness, died on November 13 at the age of forty-three years.

Dr. Hiram Miller Showalter, professor of biology at King College, Bristol, Tenn., died on November 12 at the age of thirty five years His published papers have been concerned with the cytology and genetics of Mirabilis For several years prior to his death he was engaged in a cytogenetical survey of the Tradescantias of the Great Smoky Mountains of Tennessee and North Carolina.

Frederick Clemens Zeisberg technical investigator of the development department E I du Pont de Nemours and Company, and president, American Institute of Chemical Engineers died on November 12 at the age of fifty years

Glen P Van Eseltine associate in research in the division of pomology at the New York State Agricultural Experiment Station, Geneva died on November 15 at the age of fifty years

A correspondent writes William Hudson Behney died on October 28 He was assistant professor of zoology at the University of Vermont, with which university he had been connected for ten years, as research fellow assistant in zoology, instructor and associate professor He was granted in May, 1938, a year's leave of absence to work for his Ph D degree having received his master of science degree from the university in 1930 But in September last he was appointed director of the Fish and Game Service of Vermont Hardly had he begun the duties of this new position, still retaining his connection with the state university, when he was stricken with a serious illness malignant peritonitis, which three weeks later brought about his death A young man of only thirty six years, of remarkable promise and accomplishment, especially in the field of stream ecology and fish biology, Behney's untimely passing has deprived the country of one of the most zealous and devoted naturalists of his generation"

A memorial meeting of friends, associates and former students of Dr Abram T Kerr, who until his death last August had been secretary of the Medical College of Cornell University at Ithaca for thirty-six years, was held on October 30 Dr Benjamin F Kingsbury, professor of histology and embryology at Cornell University, presided and spoke of Dr Kerr's long service at Cornell University, Dr Dean F Smiley, medical adviser, spoke of his influence in establishing hygiene instruction, and Professor Simon H Gage professor of histology and embryology, emeritus, spoke of him as former student

An oil portrait of the late Dr Charles H Herty will be presented by the Alumni Society of the University of Georgia to the university, where he was a member of the class of 1886 and where he taught chemistry for many years

It is reported in *Nature* that the Council of the Royal Society of Edinburgh, with permission of the Hon Lord Robertson, have caused to be incised on the house at 14 India Street, Edinburgh, the following inscription

JAMES CLERK MAXWELL
NATURAL PHILOSOPHER
BORN HERE 13 JUNE 1831

A new statue of Carl Linnaeus, father of modern systematic botany, has been erected near the University of Lund, Sweden

SCIENTIFIC EVENTS

THE ESTABLISHMENT IN THE DEPARTMENT OF STATE OF A DIVISION OF CULTURAL RELATIONS

The Secretary of State, the Honorable Cordell Hull, has signed the following departmental order establishing in the Department of State a Division of Cultural Relations

For the purpose of encouraging and strengthening cultural relations and intellectual cooperation between the United States and other countries it is hereby ordered that there shall be established in the Department of State a Division of Cultural Relations

The division will have general charge of official international activities of this department with respect to cultural relations, embracing the exchange of professors, teachers and students, cooperation in the field of music, art literature and other intellectual and cultural attainments the formulation and distribution of libraries of representative works of the United States and suitable translations thereof; the preparations for and management of the participation by this government in international expositions in this field supervision of participation by this government in international radio broadcasts, encouragement of a closer relationship between unofficial organizations of this and of foreign governments engaged in cultural and intellectual activities, and, generally, the dissemination abroad of the representative intellectual and cultural works of the United States and the improvement and broadening of the scope of our cultural relations with other countries

In fulfilling its functions, the Division of Cultural Relations will direct the conduct of exhaustive studies and have responsibility for the elaboration and the carrying into effect of a comprehensive and coordinated plan of activity in this country for the strengthening of international intellectual and cultural relations; it will assist in the preparation and interpretation of treaties in this field; it will supervise the formulation of regulations and procedure necessary for the fulfillment of obligations under the Convention for the Promotion of Inter-American Cultural Relations and other treaties and conventions relating to cultural relations to which the United States may become a party; it will draft or review correspondence with foreign governments, American diplomatic and consular officers and all other correspondence pertaining to these activities; it will collaborate with the Office of Education and other government departments and agencies, the National Committee on Inter-American Intellectual Coöperation, other educational and cultural organizations and institutions and foreign missions in Washington.

The Division of Cultural Relations will function under the general supervision of the Under Secretary of State and in close cooperation with the geographical divisions.

Mr. Ben M. Cherrington has been appointed Chief of the Division of Cultural Relations.

The symbol designation of the division shall be RC. The chief clerk and administrative assistant will provide the essential clerical assistance and equipment for the new division, within the limits of appropriated funds.

The provisions of this order shall be effective on July 28, 1938, and shall supersede the provisions of any existing order in conflict therewith.

THE MACDONALD OBSERVATORY OF THE UNIVERSITY OF TEXAS

DR. OTTO STRUVE, director of the Yerkes Observatory of the University of Chicago and joint director of the MacDonald Observatory, situated on Mount Locke in the Davis mountains, has reported to the University of Texas that the polishing of the 82-inch mirror for the MacDonald Observatory of the university has been completed and it "can be safely accepted." Dr. Struve wrote:

> Tests made on October 15 indicate that the great 82-inch mirror is finished. The surface is a paraboloid of 319.66 inches focal length and the actual figure of the glass does not depart from the mathematical shape by more than about one millionth of an inch. This extraordinary degree of perfection is the outcome of exactly four years of gruelling work of grinding and polishing on the part of C. R. Lundin, optician for the Warner and Swasey Company of Cleveland, Ohio. During the past four years astronomers of the University of Chicago's Yerkes Observatory have made many accurate tests of the mirror. But only now are they fully satisfied that the new mirror will be as perfect as their investigations require.
>
> The mirror will next be coated with a thin layer of highly reflecting aluminum. Before it is shipped to Fort Davis, two small convex mirrors must be completed, but optical experts believe that this should not require more than a few weeks' work. Shipment will be made before the end of December, and astronomical research with the large telescope will be commenced about the first of next year. By next spring all remaining tests should be completely finished.
>
> The 82-inch mirror is at the present time the second largest finished astronomical mirror in the world. It is surpassed only by the 100-inch mirror at the Mount Wilson Observatory, Pasadena, Calif. After the completion of the 200-inch mirror of the California Institute of Technology, the Texas mirror will rank third in the entire world. It is of interest that the three largest astronomical mirrors are all in the United States. The fourth and the fifth are located in Canada, at the University of Toronto Observatory and the Dominion Observatory in Victoria, B. C. The sixth mirror in size is again in the United States, at the Perkins Observatory of Ohio Wesleyan University. A 76-inch reflector is now under construction for the Radcliffe Observatory in South Africa. The University of Michigan is contemplating the construction of a reflecting telescope of more than 90 inches in diameter. The disc for this mirror has already been cast, but no optical work has been started.

WORK OF THE GRAY HERBARIUM OF HARVARD UNIVERSITY

IT is reported in *The Harvard Alumni Bulletin* in an account of the work of the Gray Herbarium that, beginning in early April, 1937, Professor Merritt L. Fernald, '97, director of the herbarium, started field work in Virginia, and made six trips, the last in October, into the coastal plain south of the Rappahannock. This work, made possible through a generous and anonymous gift from a friend of the herbarium, and carried out with the cooperation of Bayard Long, of the Academy of Natural Sciences of Philadelphia, is greatly altering the understanding of the history of life in eastern North America. The fourth paper resulting from the Virginia work, "Local Plants of the Inner Coastal Plain of Southeastern Virginia," with 137 pages, 15 plates and 59 maps, was issued last winter; the fifth paper, of similar extent, is now being issued.

The senior curator, Charles A. Weatherby, has continued his critical studies of tropical American ferns, resulting from his prolonged visit to the European herbaria, where he made detailed notes on, and photographs of, historical type-specimens from which American species were early described. The junior curator, Dr. Lyman B. Smith, has devoted much time and energy to the collection and organization of authentic specimens for distribution to the principal herbaria of the world in the "Plantae Exsiccatae Grayanae."

During last winter and spring, Dr. Eric Hultén, curator of the herbarium of the University of Lund, spent many weeks at the Gray Herbarium, working on his projected flora of Alaska. Dr. Hultén's intensive knowledge of northern floras and the problems of northern biogeography made him a stimulating contributor in the weekly conferences of advanced students. Dr. Harold A. Senn, national research fellow, has completed his detailed study of the genus *Crotalaria*. His extended and important taxonomic monograph and cytological studies will be published as a "Contribution" from the Gray Herbarium. Professor L. O. Gaiser, of McMaster University, whose cytological work on the American genus *Liatris* is throwing light on its complications, spent much of the summer studying and annotating the material at the herbarium.

Professor Liberty Hyde Bailey, whose first work on the genus *Carex* was published by the herbarium in 1886, made a visit to the herbarium in September, studying, in his eighty-first year, the intricate sources of cultivated plants. Professor Bailey is the only living associate of Asa Gray.

Dr. Kenneth F. Baker, of the experiment station of the Pineapple Producers Cooperative Association of the Hawaiian Islands, *en route* to tropical South America to study and collect wild species of the pineapple group, spent several days in consultation with Dr. Smith, one of the world's authorities on this family of plants, and will later have the assistance of Dr. Smith in interpreting his results. Ernest Rouleau, curator of the herbarium of the University of Montreal, spent the summer at the Gray Herbarium as a special research fellow, studying herbarium technique.

THE EASTERN SHADE TREE CONFERENCE

A MEETING will be held at the New York Botanical Garden in Bronx Park on December 8 and 9 to consider problems arising out of the damage done to trees during the hurricane of September 21. The call for the meeting is being issued by Dr. William J. Robbins, director of the Botanical Garden, at the request of a committee composed of W. O. Filley, forester at the Connecticut Agricultural Experiment Station; Dr. B. O. Dodge, plant pathologist at the garden; and Dr. E. P. Felt, director and chief entomologist at the Bartlett Tree Research Laboratories. Mr. Filley will serve as temporary chairman of the meeting, which will be opened with a short address by Dr. Robbins.

The loss of a million or more good trees in the eastern states during the hurricane which swept up the coast and across New England is the motive of the gathering, which is to be known as the Eastern Shade Tree Conference. The aim is to study the selection and culture of more sturdy, storm-proof trees; to propose a program of rehabilitation of damaged trees; and to endeavor to gain a greater control over tree diseases and pests for the protection of trees in future years.

Some of the special problems incidental to the damage wrought by the hurricane include more concentrated attention to the pests of trees which are increasing in this area. Of special importance is the Dutch elm disease, which is carried by a beetle which breeds in weak or unhealthy trees. Half a dozen other ravaging insect and fungous pests will be taken under consideration at the conference. The problems connected with them are outlined by Dr. Felt as follows:

> The gipsy moth, a serious pest of shade and forest trees, has been slowly extending its range westward and has now become abundant in several localities in western New England close to or near the barrier zone. The control of this insect is becoming a general problem.
>
> The European spruce sawfly, a recently introduced species established over much of New England, has caused serious damage to spruce forests in limited areas in Maine, New Hampshire and Vermont and may develop as a destructive pest of Norway spruce.
>
> The Japanese beetle has been steadily extending the range of serious infestation in New Jersey and adjacent areas and is now becoming extremely abundant and injurious in southeastern New York and southwestern New England.
>
> The elm leaf beetle has defoliated many trees in the Hudson River Valley and in New England during the past 40 years. It is more than probable that this insect has played an important part in weakening many of the shade trees which were badly damaged by the hurricane. This is also true of canker worms and forest tent caterpillars.
>
> The willow scab fungus is a disease which has killed many thousands of willow trees in the East. Its control is another of the serious problems for the tree owner. There are, in addition, the Sphaeropsis on Austrian pine and the Cytospora of the Norway and Colorado blue spruces.

THE AMERICAN ORNITHOLOGISTS' UNION

THE fifty-sixth annual meeting of the American Ornithologists' Union was held at the U. S. National Museum, Washington, D. C., from October 17 to 21, 1938, with a registered attendance of two hundred and thirty-three. Fifty-nine scientific papers were read—many illustrated by color slides or films. The three days of program sessions included a like number of evening entertainments; open house at the museum, the annual dinner and business meetings of various sections. On Friday the more than two hundred ornithologists in attendance visited the agricultural research center at Beltsville, Md. Many remained on Saturday for a conducted tour of the National Zoological Park.

Officers elected for the new year were as follows: *President,* Dr. Herbert Friedmann, Washington, D. C.; *Vice-presidents,* Dr. J. P. Chapin, New York City; Dr. J. L. Peters, Cambridge, Mass.; *Secretary,* Dr. Lawrence E. Hicks, Columbus, O.; *Treasurer,* Rudyerd Boulton, Chicago; *Council,* W. L. McAtee, Washington, D. C.; John T. Zimmer, New York City, and Robert T. Moore, Pasadena.

The Brewster Medal award was made to Dr. Thomas S. Roberts for his volumes on "The Birds of Minnesota." One fellow, Dr. Ira N. Gabrielson, Washington, D. C.; two honorary fellows, Eliot Howard, of England, and Jacques Berlioz, of France, and six corresponding fellows, K. A. Hindwood, Australia; Konrad Lorenz, Austria; Wilhelm Meise, Germany; R. E. Moreau, Tanganyika, Africa; Ernst Shuz, Germany; N. Tinbergen, Netherlands, were elected.

In addition to 337 new associate members, eight new members were named: Thomas T. McCabe, Harold Michener, Gayle B. Pickwell, E. Lowell Sumner, Jr., of California; Austin L. Rand, New York, Alexander F. Skutch, Maryland, Herbert G Deignan, Washington, D C., and S Gilbert Emilio, Massachusetts.

The 1939 meeting will be held in the San Francisco Bay region of California from June 19 to 23 Dr Alden H. Miller, of Berkeley, is the chairman of the local committee Dr Alexander Wetmore, of the U S National Museum, has been named president of the eleventh International Ornithological Congress, which will hold a joint meeting with the American Ornithologists' Union at the Philadelphia Academy of Sciences in May, 1942.

LAWRENCE E HICKS,
Secretary

SYMPOSIA AT BROWN UNIVERSITY ON INTERMOLECULAR ACTION

A THREE-DAY meeting on "Intermolecular Action," sponsored by the Division of Physical and Inorganic Chemistry of the American Chemical Society, will be held at Brown University on December 27, 28 and 29. The members will attend the ceremonies dedicating the Metcalf Research Laboratory of the university on Wednesday afternoon, December 28

In a series of twenty two scientific papers, thirty eight chemists will discuss "Gases and Pure Liquids," "Non Polar Mixtures," "Highly Polar Mixtures "Polar Mixtures" and 'Ionic Solutions.' Professor George Scatchard, of the Massachusetts Institute of Technology, chairman of the division, will preside

Among the speakers will be Professor Joel H Hildebrand, of the University of California, who was recently awarded the 1939 William H Nichols Medal of the New York Section of the American Chemical Society for his studies of liquid and solid solutions, Professor John G Kirkwood, of Cornell University, to whom was awarded the $1,000 American Chemical Society Award in Pure Science for original contributions in the field of intramolecular forces, Dr F London, of the Institut Henri Poincaré, Paris, at present visiting lecturer at Duke University, and Professor Charles A Kraus, of Brown University, president-elect of the American Chemical Society

Dr Niels Bjerrum, professor of chemistry at the Royal Veterinary and Agricultural College, Copenhagen, visiting lecturer at Brown University, and Dr Frederick G Keyes, head of the department of chemistry at the Massachusetts Institute of Technology, will deliver the dedication lectures on Wednesday afternoon Dr Bjerrum's subject will be "The Development of the Theory of Electrolytes," and Dr Keyes will speak on "Contrasts"

The committee on arrangements, in addition to Professor Scatchard, includes Professors Cohn, Eyring, Hildebrand, Kraus and LaMer, Professor Farrington Daniels, of the University of Wisconsin, Dr Louis S Kassel, of the U S Bureau of Mines Experiment Station, Pittsburgh, Professor Philip A Leighton, of Stanford University, Professor Samuel C Lind, of the University of Minnesota Wilber G Parks, of Rhode Island State College Thomas H Roberts, of Edgewood, R I, and Professors Earle K Strachan and Laurence S Foster of Brown University Dr Harold C Urey, of Columbia University is secretary of the division

SCIENTIFIC NOTES AND NEWS

THE hundred and third meeting of the American Association for the Advancement of Science will be held at Richmond, Va., from December 27 to December 31 Dr Wesley C Mitchell, professor of economics at Columbia University, will preside, and the address of the retiring president will be given by Dr George D Birkhoff, professor of economics at Harvard University The preliminary program of the meeting, edited by Dr F R Moulton, permanent secretary of the association, will be printed in next week's issue of SCIENCE. The first event of the meeting, except the meeting of the executive committee, will be on Monday evening, when a dinner will be given to members of the National Association of Science Writers and to editors of Virginia newspapers in honor of Austin H Clark, of the Smithsonian Institution, formerly director of the press service of the association. Sir Richard Gregory, editor of *Nature*, will be the principal speaker.

DR. BERNARD SACHS has been elected a corresponding member of the Société Suisse de Neurologie 'for eminent scientific merits and the prolific influence of his research work on the progress of neurology"

DR. MORLEY FLETCHER will represent the Royal College of Physicians, London, at the opening of the Royal Australasian College of Physicians. He will be presented with an illuminated address and a replica of the silver wand or caduceus, which was presented to the college by Caius in 1556.

ACCORDING to the *Journal* of the American Medical Association, the State Medical Society of Wisconsin at its annual meeting in Milwaukee presented the gold seal of the society to Dr Eben J Carey, dean of the School of Medicine of Marquette University, and to Dr. William Shainline Middleton, dean of the Medical School of the University of Wisconsin. Dr. Carey was honored for his "high accomplishments in medical education and research" and for his "perfection of the art and dynamic use of visual education as a means of furthering the health of our citizenry." The seal was awarded to Dr. Middleton "for accomplishments and lofty inspiration in the teaching of students and practitioners, for a quarter of a century of public service and for outstanding influence in the development of a high quality of medical service for the citizenry of Wisconsin."

A DINNER in honor of Professor S. J. Holmes, of the University of California, president of the American Eugenics Society, will be given by the society at the Town Hall Club, New York City, on November 30. Professor Holmes will preside and Dr. Albert E. Wiggam will be toastmatser. The speakers and their subjects will be as follows: Frederick Osborn, "The American Concept of Eugenics"; Professor Henry P. Fairchild, "Family Limitation Necessary to Eugenics in a Democracy"; Mrs. Sidonie Matsner Gruenberg, "The Eugenic Significance of Child Study," and Ralph P. Bridgeman, "The Eugenic Significance of Parent Education."

AT the October meeting of the Indiana Chapter of the Society of Sigma Xi the following officers were elected: *President*, G. S. Snoddy, psychology; *Vice-president*, R. J. Hartman, chemistry; *Secretary*, M. L. Lohman, botany; *Treasurer*, R. L. Kroc, zoology. Dr. Raymond Pearl, of the Johns Hopkins University, lectured on the subject of "Human Fertility."

DR. LEONARD J. PICCOLI, professor of materia medica, pharmacology and physiology at Fordham College of Pharmacy, has been elected the first president of the American Association for the Advancement of Professional Pharmacy.

THE Council of the Royal Society, London, at its recent meeting recommended the following for election as officers and as members of the council at the anniversary meeting to be held on November 30: Sir William Bragg, *president;* Sir Henry Lyons, *treasurer;* Professor A. V. Hill and Professor A. C. G. Egerton, *secretaries;* Sir Albert Seward, *foreign secretary.* Other members of the council: Professor F. C. Bartlett, Professor F. E. Fritsch, Professor M. Greenwood, H. L. Guy, Sir Thomas Holland, Dr. A. D. Imms, Professor C. K. Ingold, Professor G. B. Jeffery, Professor J. Mellanby, Professor J. Proudman, Dr. F. L. Pyman, Professor O. W. Richardson, Professor W. W. C. Topley, Professor D. M. S. Watson, Professor R. Whiddington, Professor R. Whytlaw-Gray.

AT the annual statutory meeting of the Royal Society of Edinburgh held on October 24, the following council was elected: *President*, Sir D'Arcy Thompson; *Vice-presidents*, Professor F. A. E. Crew, Lieut.-Col. A. G. M'Kendrick, Principal J. C. Smail, Professor J. Walton, Dr. James Watt, Professor E. T. Whittaker; *General Secretary*, Professor James P. Kendall.

DR. WILLIAM E. RITTER, who retired with the title emeritus in 1923 as professor of zoology of the University of California and director of the Scripps Institution of Oceanography, observed his eighty-second birthday on November 19.

INGE LYSE, who has resigned as research professor of engineering materials at Lehigh University, has become professor of reinforced concrete and solid bridges at the Norway Institute of Technology at Trondheim.

DR. F. A. WATERMAN, research assistant at the Ohio State University for the past year, is filling the vacancy caused by the appointment of Dr. E. L. Rice as acting president of Ohio Wesleyan University. He has been made assistant professor of zoology for a one-year period.

PROFESSOR G. F. MARRIAN, of the University of Toronto, has been appointed to the chair of chemistry in relation to medicine at the University of Glasgow, in succession to Professor George Barger, who now holds the chair of chemistry.

DR. ROBERT STEVENSON AITKEN has been appointed Regius professor of medicine in the University of Aberdeen in succession to Professor L. S. P. Davidson, who resigned recently. Since 1935 Dr. Aitken has been university reader in medicine and assistant director of the medical department in the British Postgraduate Medical School, London.

PROFESSOR A. F. BERNARD SHAW has been appointed to the joint post of professor of pathology in the University of Durham and pathologist to the Royal Victoria Infirmary, in succession to Professor Stuart McDonald.

THE Committee on Scientific Research of the American Medical Association has made a further and final grant to the University of Chicago in aid of a study of high blood pressure being carried on by Dr. Dallas B. Phemister, of the department of surgery, and Dr. Harwell Wilson, of the department of medicine. The project, which received two prior grants from the committee, is investigating methods of producing high blood pressure in laboratory animals through the nervous structure and through chemical factors.

DR. C. S. MYERS, successively director and principal of the British National Institute of Industrial Psychology since its foundation in 1921, retired from the active direction of its work in October. He has accepted the honorary post of scientific adviser, which will maintain his past contact with the scientific aspects of the industrial and vocational work and in which he will continue to supervise its research activities and publications.

Wilfred Norman Edwards, deputy keeper, has been appointed to the vacancy in the keepership of the department of geology of the British Museum, London, that will arise on the retirement on December 29 of Dr. W. D. Lang. Mr. Edwards is known for his work on fossil plants.

The Secretary of State for Scotland has appointed J. A. Symon to represent the Department of Agriculture for Scotland on the committee appointed to advise him on matters connected with the administration of the Wild Birds Protection Acts.

Dr. Langley Porter, dean of the Medical School of the University of California, is visiting medical schools of a number of universities of the United States and Canada. Dr. Chauncey Leake, professor of pharmacology, is acting dean during his absence from the university.

Dr. Paul A. Zahl, of the Haskins Laboratory of Union College at Schenectady, N. Y., left on November 19 for British Guiana, where he will conduct a collecting expedition in the Mt. Roraima area at the tri-juncture of British Guiana, Venezuela and Brazil. Because of the unique isolation of Mt. Roraima, previous expeditions have required months of difficult transit. Dr. Zahl and his group will attempt to fly directly from Georgetown to the base of Mt. Roraima. The present trip is his third to the American tropics to collect living specimens of various Ponerine ants.

Dr. George Sarton, research associate in the history of science at the Carnegie Institution of Washington, gave on November 17 a lecture entitled "Science during the French Revolution," at the Carnegie Institution of Washington. On November 22, Dr. Arthur L. Day gave an illustrated lecture on "The Hot Springs of New Zealand."

Sir Richard Gregory gave early in November the first of a series of five lectures on "Religion as a Social Force" in the Senate House of the University of London. His lecture was entitled "Religion and Science." The other lecturers and their subjects are: Sir Eric Maclagan, on "Religion and Art"; Dr. T. H. W. Armstrong, on "Religion and Music"; Lord Stamp, on "Religion and Business," and the dean of St. Paul's on "Religion and Philosophy."

The annual fall meeting of the American Mathematical Society will be held this year in Cleveland on November 25 and 26 with Case School of Applied Science and Western Reserve University acting as joint hosts. Approximately 100 delegates are expected to attend the sessions on Friday afternoon and Saturday morning in the Bingham Building of the institute. A convention banquet for the delegates and their wives will be held on Friday evening at 6:30 in Hayden Hall of Western Reserve University. The principal speakers for this year's meeting will be Professor C. C. MacDuffee, of the University of Wisconsin, and Professor V. G. Grove, of the Michigan State College.

The Society of Rheology will hold its tenth annual meeting on December 28 and 29 at the Mellon Institute of Industrial Research in Pittsburgh. Technical sessions will be held on the two mornings of the meeting, and on the afternoon of December 28 there will be a joint meeting on "Fluid Mechanics" with the Chemical Engineering Symposium of the Carnegie Institute of Technology. The annual dinner will take place on the evening of December 28, and the business meeting will follow luncheon on December 29.

It is reported in *Nature* that the twenty-fourth meeting of the Australian and New Zealand Association for the Advancement of Science will be held at Canberra from January 11 to 18, 1939, under the presidency of Professor Ernest Scott, emeritus professor of history in the University of Melbourne. Six men of science from Great Britain have accepted invitations to attend this meeting. They are: Professor F. T. Brooks, Sir John Flett, Dr. Julian Huxley, Sir John Russell, Dr. N. V. Sidgwick and H. G. Wells. The presidents of the sections are as follows: Astronomy, Mathematics and Physics, Professor T. Parnell; Chemistry, W. Russell Grimwade; Geology, Professor R. Speight; Zoology, E. J. Goddard; History, Professor S. H. Roberts; Anthropology, F. E. Williams; Economics, Statistics and Social Science, L. G. Melville; Engineering and Architecture, Sir Henry Barraclough; Medical Science and National Health, Dr. E. Sydney Morris; Education, Psychology and Philosophy, J. R. Darling; Agriculture and Forestry, Dr. W. L. Waterhouse; Veterinary Science, Dr. L. B. Bull; Botany, Professor J. G. Wood; Physiology, Professor W. J. Young; Pharmaceutical Science, Dr. E. M. Watson; Geography and Oceanography, G. A. V. Stanley.

The New York Academy of Sciences has reduced the active membership dues from ten to five dollars a year, to take effect on January 1. Also a new grade of membership has been established for active members desiring to continue their present support of the academy, to be known as sustaining membership. The annual dues for this grade will be ten dollars a year. Such members will receive, each year, a part of the Puerto Rico Survey, in addition to all current numbers of the annals and other publications of the academy, which active members will continue to receive as formerly. After having paid annual dues of ten dollars for twenty-five successive years, sustaining members have the additional privilege of requesting transfer to the life membership class without further payment of dues.

Lord Nuffield has given £25,000 towards a fund to enable the British Institution of Production Engineers, of which he is the president, to proceed at once with the creation of its proposed Production Engineering Research Department, under the charge of Professor Georg Schlesinger.

The University of Oregon Medical School at Portland, one unit of the Oregon State System of Higher Education, is the recipient of three substantial gifts for instructional and research facilities. The Julius L. Meier family has given $50,000 as a memorial to former Governor Julius L. Meier to be used in supplementing a state appropriation of $110,000 and a PWA grant of $130,909 in the erection of a tuberculosis hospital on the campus of the Medical School and as a part of the university hospitals and clinics. Margaret M. Widmer and Gertrude D. Widmer, graduates of the university, have given the Medical School a farm valued at $30,000, the income to be used in research on heart disease and cancer, the endowment to be known as the "Widmer Memorial Research Fund of the University of Oregon Medical School." Dr. John E. Weeks, of Portland, recently gave $100,000 toward the construction of a medical library, auditorium and laboratory building. This gift was matched by the Rockefeller Foundation, and a grant was secured from the Public Works Administration for an additional $163,350, thereby making it possible to erect a building costing $363,350. The structure will provide the most modern facilities for a large medical library, an auditorium seating six hundred for student and professional gatherings, and a laboratory unit for medical research. Construction on the new tuberculosis hospital and the library, auditorium and laboratory building is now under way.

The Hall of Pharmacy at the New York World's Fair of 1939, constructed at the cost of $1,000,000, was dedicated on the afternoon of Sunday, November 13. The hall occupies 45,000 square feet of space, sufficient to accommodate several score exhibitors.

The Kansas State Herbarium has now been transferred to a large fireproof vault on the grounds of Kansas State College, at Manhattan. This herbarium was started in the 1870's by W. A. Kellerman, greatly augmented by A. S. Hitchcock up to 1901, and further enlarged under its present curator, F. C. Gates, during the past twenty years. The collection contains about 90,000 sheets and is particularly full from each of the various counties of Kansas.

At the U. S. Geological Survey, plans have been made for starting immediately the construction, repair and improvement of river measurement stations, for which $590,000 of Public Works funds have been allocated. Such work will be performed in practically every state in accordance with the approved allotments by states and handled through the district offices of the Geological Survey. Similar arrangements have been made for commencing immediately the Public Works program relating to the surveys of floods and droughts for which $100,000 has been appropriated. Field work has been started on the following PWA projects of the Geologic Branch: Investigations of manganese deposits in the Olympic Mountains, Washington; of phosphate deposits in Wyoming; and of mineral deposits in Strawberry Valley, Utah, and in the Henry Mountains, Utah; and classifications of coal lands in Wyoming and Montana. These projects are in charge of C. F. Park, W. W. Rubey, A. A. Baker and Charles Hunt, respectively.

The *Journal* of the American Medical Association reports that committees representing Cornell University Medical College and the University of Havana Faculty of Medicine have arranged for exchange students and teaching staff for periods of study. Four undergraduate students and/or members of the teaching staff of Cornell will study parasitology, tropical diseases or any other subject of special interest for six weeks in the summer in Havana under the auspices of the university. Three undergraduates in medicine and/or members of the teaching staff of the University of Havana will have the opportunity of studying at Cornell for a period of eight weeks, one each in the fall, winter and spring. Each university agreed to grant to each visitor on satisfactory completion of the work a certificate covering the studies pursued and the time employed thereon. The studies at the respective schools will be supervised by special committees. Dr. Wilson G. Smillie is chairman of the committee at Cornell and Dr. Alberto Inclán of the one in Havana. The agreement is in effect for one year.

DISCUSSION

WHY WE SELDOM SEE A LUNAR RAINBOW

The fact that we see the lunar rainbow only once to the hundred times, more or less, that we see the sun-caused, or solar, bow, we instinctively attribute to the great difference between the brightness of the sun and that of the moon. The brighter the light the brighter the bow, of course, other things being equal, and the brighter the bow the more likely we are to see it. Q.E.D., as Euclid used to say when he had clinched the argument. In this case, however, the argument isn't yet clinched. If the relative frequencies of the solar and lunar rainbows were merely a question of the comparative brightnesses of the two luminaries, we then should expect to see halos, kindred phenomena, about the sun far more frequently than around the moon, but that does not appear to be their ratio. Many people insist that though the sun is up all of every day and the moon below the horizon half, on the average, of every night, still they see the lunar halo more frequently than the solar and claim at the same time that they are awake all day long and asleep through most of the night. This contrast—the fact that the lunar halo is (or seems to be) more frequently seen than the solar halo—is owing, largely at least, to the fact that at night there is no blinding glare from the light of the sky, while in the daytime it often is so intense as to discourage close observation, and to render relatively inconspicuous local intensifications, such as constitute the halo. This is evidenced by the fact that solar halos, and solar coronas, especially, are much more conspicuous when seen in a black mirror, or even in a quiet puddle of dirty water, than when viewed directly in the sky.

But our concern here is with the rainbow, not the halo, which got into the argument surreptitiously. Obviously a lunar rainbow would be faint beyond detection if produced under the same conditions by which the solar bow could just be seen; but on the other hand if the two bows were intrinsically equally bright the night bow might still be clearly seen while the daytime one was lost in the ever-present glare. However, the glare from the region about a rainbow generally is far less than that caused by the thin clouds in the neighborhood of a solar halo. Hence it would seem that if the brightness of the parent luminary and the glare of the sky were the only things that affected the visibility of a rainbow the advantage then would be decidedly with the solar bow. And there are other conditions that intensify this disparity, as will appear from a consideration of the fact that a bow can be seen in only that portion of the rain which is directly illuminated by the sun or moon. This means that the rain cloud is of quite limited extent, at least on the side facing the luminary—not extensive enough to shade the falling rain in which the bow appears. Hence a local convectional shower is more likely than any other to give a rainbow display. Now, over land, where people live anyway, the large majority of such showers occur in the summer afternoon, a time when the sun has every chance to produce a bow and the moon no chance at all.

Furthermore, the most likely time for the appearance of a lunar bow is when the moon is nearly full, and as early as possible after dark, that is, before a local or heat thunderstorm has fully rained out. That particular time, then, is from 8 to 10 o'clock P.M. This means that in mid latitudes, at least, the moon bow is most likely to be seen to the west of the observer. But normally, owing to the fact that the winds are prevailingly from the west and grow stronger with increase of height, the sky is too much covered with blown cloud to the east of the storm to allow direct light from sun or moon to reach the falling rain.

Finally, the moon is in the right phase during the right hours only 3 days, or so, each month, while the sun, always in full glow, is in the proper position every day.

In short, therefore, over land solar bows are far more frequent than lunar bows because:

1. The sun is many times brighter than the moon.
2. The local, or rainbow, shower occurs most frequently in the afternoon and far less often at night.
3. Sunshine often can reach the west or (commonly) windward side of a local shower, the side of least canopy, whereas the light from a nearly full moon, coming from the east, is likely to be intercepted by a layer of cloud.
4. Finally, the sun is in condition and position suitable for the production of a bow every day, and the moon one tenth of the days.

The moon then has such a poor chance to produce a conspicuous bow that it is a wonder that anybody ever sees one, and most people never do. What that chance is can be computed a little closer, perhaps, than one can just guess it. Consider the central portion of the United States. Here about 50 thunderstorms are recorded per year from any given point, but of these only 15, at most, bring rain to the place of observation. Furthermore, it would be liberal, perhaps, to assume that 5 of these occur at night. Again, the moon is in the proper phase and position to produce a rainbow on only one tenth of the nights. Thus far, then, the chance of a lunar bow has been reduced to one in two years. But that is not all, probably only once in 5 times is the sky clear enough in front of a night thunderstorm to permit full illumination of the oncoming sheet of rain; and, finally, from the fact that most of the solar bows are faint it would seem that only one third, at most, of the lunar bows can be visible. Hence once in 30 years is about as often as a close observer in the central portion of the United States may expect to see a lunar rainbow, and as most of us are likely to miss at least three out of four such bows that might be seen, the average inland dweller is lucky if he ever sees one.

However, along certain coasts, and over particular oceanic regions, the chance of seeing a lunar rainbow, and solar bow too, for that matter, is better than it is far inland, because there the passage of cold air starts at any time a convection shower with a rather limited cloud canopy.

Nevertheless, conditions 1 and 4, above, are the same there as on land; hence even over the ocean the lunar bow is a comparatively rare phenomenon.

W. J. HUMPHREYS

U. S. WEATHER BUREAU,
WASHINGTON, D. C.

OBSERVATION OF A LUNAR RAINBOW BY FRANKLIN

WHILE reading Carl Van Doren's biography of Benjamin Franklin I was reminded of Professor A. K. Lobeck's report (SCIENCE, August 26, 1938) on his observation of a rainbow at night. In 1726, at the age of twenty Franklin kept a journal of his return trip from England to America. The *Berkshire* sailed into the Channel on August 5. Under the date of Tuesday, August 30, young Franklin recorded that "the moon being near full as she rose after eight o'clock, there appeared a rainbow in a western cloud, to windward of us." He also had the experience on this trip of witnessing an eclipse of the sun and an eclipse of the moon just fifteen days apart.

RAYMOND L. HIGHTOWER

KALAMAZOO, MICH.

FREQUENCY OF LUNAR RAINBOWS

A RECENT note by Lobeck recognizes the fact that to most continental residents a lunar rainbow is a distinct novelty.[1] Lobeck also infers greater frequency of lunar rainbows in the trade wind belt, due to thunder squalls. However this may be, it is the purpose of this note to point out that both solar and lunar rainbows are relatively frequent in occurrence in the Hawaiian Islands, where most of the geographically variable rainfall is of orographic origin, *i.e.*, due to cooling of trade winds in passing over rugged island topography. Here, where local showers and mists occur sporadically on days and nights which are generally clear, are ideal conditions for rainbows, and persons in certain localities probably see rainbows almost daily at certain seasons. Any one who has occasion to travel about in upland districts ordinarily sees two or more rainbows a week. Near the full moon, lunar rainbows are often seen and certainly the matters of common knowledge to young and old in this part of the United States. In the solar rainbow, the secondary spectrum is visible more often than not, and the writer has a persistent impression of having seen the secondary spectrum in a lunar rainbow, but can not offer date or systematic observations.

CHESTER K. WENTWORTH

BOARD OF WATER SUPPLY,
HONOLULU

MASTODON DISCOVERED IN OHIO

EARLY in September, 1938, a part of the skeleton of a mastodon (Americanus) was unearthed in a field by an Amish farmer, J. J. Miller, who was digging a drainage ditch. The remains consist of a thigh bone and eight teeth, the largest of which weighs a little more than 6 pounds. The remainder of the skeleton was so badly decomposed that it could not be recovered. About ten years ago, during the excavation of a drainage ditch on the same site, the skeleton was partially destroyed by dynamite. It interfered with the digging, and the farmer, not aware of the nature of the obstruction, used the explosive to remove it.

The plot of ground on which the bones were found is located on the extreme western end of the area known as "The Plains" in Berlin Township in Holmes County, Ohio, about two miles southwest of Benton and three miles northwest of Berlin. "The Plains" is already noted for the discovery of the skeleton of a giant sloth, Megalonyx (Jeffersoni), in 1890, on the farm of Abraham Druschell. This specimen, an excellent one, is mounted and stands in the Geological Museum in Orton Hall at Ohio State University.

The remains of the giant sloth were found embedded in shell marl, beneath six feet of black earth. The bones of the mastodon were found lying on top of the shell marl and three feet below the surface beneath black earth, high in humus content. Evidently, the area known as "The Plains" was at one time a glacial lake, which was destroyed by natural processes such as the lowering of the outlet and gradual filling-in by wash and plant and animal accumulations. When finally reduced to a bog, the sloth and mastodon were probably mired in and the skeletons preserved in the bog waters.

KARL VER STEEG

COLLEGE OF WOOSTER

FRESH-WATER MEDUSAE IN TENNESSEE

ON July 15 about a half dozen live *Craspedacusta ryderi* were brought into my office. These had been collected by Miss Sara Betty Fowler from Andrew Jackson Lake, privately owned, at the suggestion of Mr. Harry McCann, custodian.

The lake, about twelve miles west of Knoxville, has an area of from 50 to 65 acres with the greatest depth of from 20 to 30 feet. When we visited the lake on the afternoon of July 15 thousands of the medusae were found at and near the surface of the water. Something like 300 were collected in a short time over a small area. These were placed in an unaerated aquarium. By July 18 most of the specimens remained on the bottom of the aquarium or had disintegrated. Only a few swam irregularly about. Eleven of the more active specimens were preserved. It was found when these were examined on September 6 that all the eleven were females.

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[1] A. K. Lobeck, SCIENCE, 88: 2278, 187, 1938.

According to Mr. McCann this is the third consecutive year that medusae have appeared in Andrew Jackson Lake. Each time they have lasted about 45 days, at the end of which time they more or less suddenly disappeared. This year they disappeared about August 3 or 4, according to Mr. McCann. None could be found when the lake was visited on August 14. As far as the writer knows, this is the first record of freshwater medusae in Tennessee.

EDWIN B. POWERS

UNIVERSITY OF TENNESSEE

HUNTING IN SOUTH AFRICA

MY attention has recently been drawn to more than one attempt, by advertisement and otherwise, to entice overseas sportsmen to the Union of South Africa with promises of facilities for big and small game hunting. These promises are couched in language that is unjustifiably optimistic, not to say misleading.

There is still much good hunting to be had in many parts of South Africa but mostly on privately owned farms, where in many cases game is carefully preserved. Speaking generally, game is to a great extent strictly protected by law throughout South Africa, particularly in the Transvaal, and permits for shooting certain species of game are only granted in those districts where those particular species are fairly numerous.

Roan antelope are being strictly protected everywhere. Only in special circumstances will permits be issued for shooting oribi, reed buck and sable antelope. Permits to shoot wildebeest, zebra, kudu, impala and waterbuck are only issued in those districts where these animals are sufficiently plentiful. Permits to shoot elephant, hippo, rhino and giraffe are not to be obtained. Even a farm of 10,000 acres well stocked with game might easily be deserted by game, other than birds, after a week or two of intensive shooting, and disappointment is bound to be the lot of many who come to South Africa on the strength of such promises.

Sportsmen who propose visiting South Africa in the hope of getting some big or small game hunting will be well advised to make the closest inquiries before concluding arrangements with persons offering hunting facilities. The Wild Life Protection Society of South Africa is prepared to give advice on game to any one who desires to visit the Union of South Africa on a shooting trip.

J. W. H. WILSON

THE STRUCTURE OF THE INSULIN MOLECULE

IN the article entitled "The Structure of the Insulin Molecule" in the issue of SCIENCE for August 12, two corrections should be made. There should be substituted for "with six slits whose centers give an octahedron," the following: "which by parallel displacement of faces through ± a/2 becomes an octahedron with the same distance between parallel faces and consequently." On page 149, line 16, first column, 66° should be substituted for 6°.

D. M. WRINCH

ABSTRACTS OF PAPERS READ AT THE AUTUMN GENERAL MEETING OF THE AMERICAN PHILOSOPHICAL SOCIETY

AT the autumn general meeting of the American Philosophical Society held in the hall of the society on Independence Square, Philadelphia, on November 18 and 19, the following papers were presented:

Agriculture and current population trends: CONRAD TAEUBER. Reproduction rates in the farm population indicate an excess of approximately two thirds above replacement needs per generation, but rates of reproduction for the non-farm population are not now sufficient for permanent maintenance of present numbers. Within the farm population there is wide variation, rates of reproduction in the native white group ranging from 1.00 in Connecticut to 2.11 in Utah and rates among Negroes ranging from 1.47 in Arkansas to 2.14 in North Carolina. In general, rates are higher in the South than in the North and West; among Negroes and other colored groups than among whites, and among foreign than among native stocks. There is an inverse relationship between level of living and population fertility ratios. While no single factor serves to account for the differentials in the rates of reproduction within the farm population, significance attaches to the nature of the prevailing agriculture. The population engaged in a rationalized, commercial agriculture tends to have lower rates of reproduction and is less elastic for population growth than that engaged in a less commercialized, more nearly self-sufficient agriculture. This relationship is especially clear in areas with approximately the same plane of living; rates of reproduction in the Southern Appalachians tend to exceed those in the Cotton Belt. Changes in farm population between 1930 and 1935 illustrate the same principle. Some of the areas where commercial agriculture is dominant lost population throughout that period, whereas areas with less highly commercialized agriculture more frequently retained their own natural increase and received migrants from non-farm areas.

The social environment as a factor in population *growth:* **Warren S. Thompson.** Not only is there evidence of a general nature that social environment affects the birth rate, but also that a large part of the differences in the birth rates as between individuals and groups are accounted for by the practice of contraception. In industrially backward countries like China, where the mores are favorable to early marriage and the raising of many children, the birth rate is high and seems likely to remain so. In many countries in Europe, notably Germany, a definite attempt is being made to influence the mores or climate of opinion in favor of earlier marriage and larger families. It seems probable that these efforts are having some effect, although it is too soon to speak with assurance. In those parts of the United States where the birth rate remains relatively high, the mores are favorable to raising large families although the economic conditions are not. If the economic motive is the chief motive leading to the practice of contraception, it must be distinguished from necessity, since the birth rate appears to be lowest in the comfortable and well-to-do classes. If the time should come when the community would like to exercise control over the birth rate, it can not do so intelligently unless the motives which actually lead to the practice of contraception have been studied carefully. Until it is clearly known why such a large proportion of the population prefers families too small to insure reproduction, it will not be possible to take measures to change this situation if it is desired to do so.

Intrinsic factors in population growth: **Frank W. Notestein.**

A study of psychological factors in relation to fertility: **John C. Flanagan.**

Voluntary and involuntary aspects of childlessness: **Clyde V. Kiser.** However important may be the practice of deliberate family limitation among urban couples for the purpose of postponing or spacing pregnancies, it appears that childlessness among women married ten years or more is an involuntary situation. This conclusion seems justified from data recently collected by the Milbank Memorial Fund with the help of the National Committee on Maternal Health. For an exploratory investigation of the problem of childlessness a questionnaire was devised for use among a selected group of married white women residing in four boroughs of New York City, representing all socio-economic classes. The schedule provided for entries concerning previous births and pregnancies. Women reporting that they had never been pregnant were asked to supply information concerning the extent of contraceptive practice since marriage. Furthermore, the childless women were asked to state whether their failure to bear a child had been a disappointment and whether they had ever sought medical advice regarding this condition. A sifting of the returns yielded a group of 291 women who had never been pregnant despite the fact that they had been married ten years or more and were under forty years of age at the time of marriage. Among these, three fourths stated that they had done nothing since marriage to prevent conception, and only 14 per cent. stated that they had regularly and constantly resorted to contraceptive practice. Furthermore, approximately two thirds of the never-pregnant women stated that their failure to have a child had been a disappointment to them, and 57 per cent. stated that they had actually consulted a physician in order to learn why they could not conceive. Similar investigations in other areas are needed for more general results, but it appears that even in a metropolis the practice of contraception can not be held responsible for any major share of permanent childlessness.

Mortality in relation to widowhood: **Mortimer Spiegelman.** The general improvement in mortality in the last century has resulted in an appreciable reduction in the chances of widowhood for both man and wife. A married man under age 50 to-day is less than half as likely to lose his wife by death in the course of the year than he would have been one hundred years back; for wives, a corresponding benefit of the same magnitude extends only up to age 40. Since the family is the social unit through which the growth of the population may be influenced, the notable reduction in the chances of widowhood at the young ages of married life, apart from other factors, has, to some extent, enlarged the potentialities for population increase. In the case of native white married women in Pennsylvania, it is found, on the basis of the latest available data (1930), that among wives of ages 20 to 24 the chances of becoming a widow in the course of a year were 2.9 per 1,000; in the age group 30 to 34 years, the chances were 4.8 per 1,000, and, for wives ten years older, namely 40 to 44 years, the chances of widowhood mounted to 9.5 per 1,000. Among men, the chances of becoming widowed in the course of a year were 3.8 per 1,000 in the age group 30 to 34 years; 5.5 per 1,000 in the age group 40 to 44 years, and 9.6 per 1,000 at ages 50 to 54 years. At every age above 34, for a married man, the chances of his own death occurring within one year are greater than the chances of his becoming widowed by his wife's death in that period. Furthermore, his chances of death increase more rapidly with advancing age than his chances of becoming widowed; on the other hand, for a woman beyond age 27, the probability of widowhood within the year is greater than the probability of death; for her, the chances of widowhood increase faster with advancing age than the chances of death.

Technological advance in relation to population trends: **Waldemar B. Kaempffert.**

Prospective development of cultural patterns in rural America and their possible influence on population trends: **Carl Cleveland Taylor.**

Anthropological aspects: **Harry L. Shapiro.**

The heavy electron: **Karl K. Darrow.** The "heavy electron" is an interesting example of a physical concept now engaged in forming itself under our very eyes. Of electrons, protons and alpha-particles it can be said that their charges and charge-to-mass ratios are determined directly, and serve for defining them; we then observe whatever other qualities they possess, such as ionizing-power, and associate these with their measured charges and masses. When however a physicist speaks of a heavy electron he is not speaking of a particle of which the charge and the mass have been measured: quite the contrary! Of heavy electrons the charge and the mass can not as yet be measured, and we are forced to base our definition of them upon what for the other particles we regard as secondary qualities. He may be speaking of a particle of which the ability to penetrate great thicknesses of heavy metal is much greater than, according to current theory, that of an electron ought to be. He may be speaking of a set of data which indicate the existence of two distinguishable kinds of particles (the distinction being made on the basis of some other property than charge and mass) where he expected to find one kind only; he may or may not be convinced that one kind consists of electrons, but at any rate he is debarred from believing that both do. In a very few but most significant cases, he can be pretty sure that a particle has exhibited an ionizing-power different not merely from what theory suggests but also from what observation confirms for an electron. Also there is reason for supposing that a particle of mass intermediate between those of electron and proton would be a welcome thing to postulate as a constituent of nuclei. To summarize: there is a variety of mysterious phenomena, of which the mysteries could perhaps be explained by assuming particles of a certain mass between those of electron and proton; if it should finally turn out that the same particle will serve for all, then the heavy electron will be established as a feature of modern physics.

The radioactivity of indium produced by slow neutrons: ALLAN C. G. MITCHELL. Ordinary indium can be made radioactive by exposure to slow neutrons. The source of the neutrons is a mixture of 200 milligrams of radium and 5 grams of beryllium which emits neutrons at a constant rate. Radioactive indium produced by slow neutrons is characterized by three periods: one of 13 seconds, one of 54 minutes and one of 45 days half-life. The period of 45 days is one of the longest ever produced by irradiation with slow neutrons from a radioactive source. Ordinary indium foil was bombarded for *six months* by neutrons from the radium-beryllium source. After irradiation the indium was placed upon a Geiger counter and its activity measured. Aside from the two short periods, already known, the long period was discovered. The activity of the long period was found to be only 2.5 per cent. of that due to the 54-minute period, indicating that it was caused by a substance formed from the rare isotope of indium (4.5 per cent. abundance) by neutron capture. The short periods due to the more abundant indium isotope were investigated after short irradiations. The beta and gamma ray spectra associated with these periods were carefully studied, and it was found that an energy level system could be drawn up which is analogous to the well-known diagrams of this type used in describing visible spectra. Furthermore, the two periods of 13 seconds and 54 minutes, belonging to the same isotope In^{116}, are said to be isomeric. Such isomeric periods can exist only if they have energy levels which are close together and which have quantum numbers differing by a considerable amount. The two energy levels in question were only 0.3 million volts apart. Quantum numbers for all states were assigned.

Adsorption calorimetry and an account of some measurements at low temperatures: RALPH A. BEEBE. The adsorption of a gas on a solid surface may be (1) activated adsorption or (2) van der Waals (physical) adsorption, and only the former of these is in general related to the catalytic activity of the adsorbent material. Because of the great difference in the characteristics of the energy changes occurring during the two types of adsorption, the calorimetric determination of the heats of adsorption provides useful evidence in deciding whether a given process belongs to the activated or the van der Waals type. A vacuum adsorption calorimeter is described which is designed to eliminate the troublesome experimental difficulties arising from the temperature gradients within the instrument. It has been shown that a gas may be held in both the activated and the van der Waals state on the same surface. Frequently the two types occur in well-separated temperature ranges, the activated type being characteristic of the higher temperature. In certain cases, however, activated adsorption is found even at liquid air temperatures occurring concurrently with the low temperature van der Waals process. In the present investigation, heats of adsorption at – 183° C. have been measured calorimetrically using the six gases, argon, hydrogen, deuterium, carbon monoxide, nitrogen, and oxygen on a reduced chromic oxide surface. The order of magnitude of the heats indicates that all these gases, except argon, are in part held in a state of activated adsorption as well as in the van der Waals state even at the low temperature of – 183°. Moreover, in the experiments with carbon monoxide, nitrogen, and oxygen, the complex form of the time-temperature curves on a partially covered surface leads to the conclusion that the adsorbed gas changes over on the surface from an initial van der Waals state to a final state of activated adsorption.

The living state of matter in the range of low temperatures: ALEXANDER GOETZ. It has been proven in the past that small living cells containing little water or being entirely dehydrated (such as spores, certain bacteria, infusoria) can survive temperatures close to the absolute zero. Cells possessing larger quantities of water have a high mortality when cooled due to the crystallization of the cell contents. It is known in general that the transition from a (colloidal) liquid into a solid—when cooled—can take place in two ways: either a crystalline conglomerate is formed where the molecules are aligned into their respective crystal lattices and where consequently the molecular arrangement of the liquid is changed in favor of a thermodynamically stable configuration—or the liquid arrangement is preserved to a large extent in a vitreous solid ("glass"). In this case the substance is thermodynamically not in equilibrium. Which of the two alternatives is chosen depends upon the rate of cooling and upon the relative stability of the molecules in the liquid. Applying these principles to live matter one should expect that the possibility for life (viability) should be preservable for all cells if they could be transformed into a vitreous state when cooled. It is probable that the successful freezing experiments are due to the small tendency toward crystallization of dry or nearly dry cells. The author reports experiments with yeast cells where the physical conditions of cooling were especially favorable to cell vitrification, resulting in a reduction of the high cold-mortality to a few per cent. (cooling rates of approximately 1,000 degrees per second, temperatures between - 182° and - 252° C., special cooling media). In similar experiments a temperature range was found in which devitrification (between ca - 100° and 0° C.) takes place in vitrified cells, *i.e.*, a gradual destruction of the "latent" life by the transition of the vitreous state into the crystalline. This phenomenon permits the calculation of a thermodynamical constant descriptive of the live system investigated.

Vascular adjustments of diving animals during apnea: LAURENCE IRVING. When breathing of a mammal is arrested, blood flow decreases through the muscles and increases through the brain. This adjustment of the circulation provides for the respiration of the brain during apnea and appears significant in the endurance of asphyxia. Carbon dioxide is the most familiar single stimulus for respiratory adjustments, and is known to produce a decrease in muscular and an increase in cerebral blood flow in most mammals. In the muskrat and beaver, however, CO_2 does not decrease muscular blood flow as it does in other mammals and therefore would be ineffective in activating the vascular adjustment against asphyxia. In addition, CO_2 is not as effective in increasing the breathing of seals, muskrats and beaver as it is in land mammals. The respiratory adjustments of diving animals resemble those of land animals, except that the divers execute the adjustments quantitatively more effectively. Diving animals show extreme respiratory adjustments, which are nevertheless mammalian in type and which may be used to indicate the small adjustments which land mammals make to avoid asphyxia during apnea. The failure of CO_2 as a respiratory stimulus in divers implies that CO_2 is not effective in activating the quick internal responses which mammals in general make to escape asphyxia during apnea.

The effect of CO_2 in water upon respiration of fish: F. E. J. FRY, E. C. BLACK and LAURENCE IRVING. When the pressure of CO_2 is raised fresh-water fish become more susceptible to lack of oxygen. The catfish is one of the least sensitive to CO_2, and the bass is one of the more sensitive species. Examination in this way of fifteen species of fish from Opeongo Lake, Ontario, shows that each species may be mathematically distinguished by its sensitivity to CO_2. Not only are specific distinctions shown by effect of CO_2, but sex and size differences have appeared as well. The effect of CO_2 conforms to the expectation from known characteristics of the blood, showing a relation to the internal physiological description of respiration. The occurrence of different susceptibilities according to species, size and sex coincides with the fact that fish of a given species, sex and size range together in particular and often restricted environments. The fish examined represent the typical population of a large lake characteristic of the Canadian Pre-Cambrian land surface. This experimental method indicates that we may use known factors of the internal respiratory processes of fish to determine their position and movements in their external environment. The implication is that the known effect of CO_2 upon internal respiratory transport presents the internal sensitivity which activates the fish in selecting a range and that the combination of CO_2 and O_2 in the environment provides the external stimulus which by affecting the internal sensitivity governs their range and migratory movements.

Factors in the progressive depletion of the world's mammalian faunas: FRANCIS HARPER. During the Christian era the world has lost by extinction about 72 forms (species or subspecies) of mammals. They are distributed as follows: Australia, 9; Malay Archipelago, 3; Asia, 4; Europe, 6; Africa, 9; North America, 24; West Indies, 13; South America, none; Falkland Islands, 1; Galapagos Islands, 2; oceans, 1. Approximately 75 per cent. of these losses have occurred during the past century, and 50 per cent. during the past half century. Thus the rate of extinction is being steadily accelerated. In addition to the mammals already extinct, some 350 or 400 others may be considered vanishing forms. Insular faunas, partly by reason of the circumscribed nature of their habitats, are particularly vulnerable to attack or competition by man and by certain mammal pests introduced by him. There may be a further reason for the decadence of insular faunas in some cases, such as that of the West Indies, in the virtually total lack of native mammal predators; these would doubtless have played a beneficial rôle by eliminating the unfit individuals, and thereby contributing to the survival of the fittest individuals, among the species preyed upon. The primary factor in the depletion of the world's mammalian faunas is civilized man, operating either directly through excessive hunting and poisoning, or indirectly through invading or destroying natural habitats, placing firearms in the hands of primitive peoples, or subjecting the primitive faunas of Australia and of various islands to the introduction of aggressive foreign mammals, including fox, mongoose, cat, rat, mouse, and rabbit. Comparatively few species seem to have died out within the past 2,000 years from natural causes, such as evolutionary senility, disease, or climatic change. The chief hope for the survival of the larger mammals of the world lies in the establishment and maintenance of a sufficient number of sanctuaries.

Sex-determination and reproductive economy in the wasp Habrobracon: P. W. WHITING. As viewed from the aspect of modern genetics, sex-determination in insects related to the honey-bee has been very puzzling. The males come from unfertilized eggs and are therefore fatherless, receiving a single set of hereditary elements from the mother alone. Females developing from fertilized eggs have a double set, one from each parent. The ratio of sex-determining factors should be the same in the double set as in the single, so that it has not been clear what causes sex difference. The small parasitic wasp Habrobracon, a close relative to the honey-bee and having the same peculiar type of reproduction with fatherless males, is easily and rapidly reared in the laboratory and its heredity has been intensively studied. It has been shown that certain abnormal sterile males resulting from inbreeding are not fatherless but develop from fertilized eggs. They have the double hereditary set. Why, then, are they males instead of females? The question has been answered by breeding experiments showing that there are two kinds of normal males, each with different sex-determining elements, X and Y. Females have a combination of the two different male sets, X + Y. The abnormal sterile males produced by inbreeding have either one or the other male set doubled, 2X or 2Y, and therefore have the same ratio of sex-determining elements as the normal males, but the female is necessarily different being a combination X + Y, of the two normal types of males, X and Y. Inbreeding not only results in sterile males, but also in many unhatchable "bad" eggs. The problem as to why these bad eggs and sterile males do not occur in cross-breeding is now being studied.

Mating types, toxic interactions and heredity in Paramecium aurelia: T. M. SONNEBORN. I. *Mating types:* The individuals of *Paramecium aurelia* are of diverse mating types; when the proper types are brought together, they give an immediate agglutinative sex reaction. There are six different mating types, but conjugation occurs only between types I and II, between III and IV and between types V and VI. In any one stock, not more than two types occur, and these are always two that interbreed. The species thus consists of three groups of stocks, with conjugation occurring freely between stocks of the same group, but not at all between stocks of different groups. The three groups of stocks not only contain different pairs of mating types, but also react sexually and conjugate at different temperatures and at different periods of the day. II. *Toxic interactions:* Two stocks produce toxic substances that kill animals of other stocks. The two toxic substances produce characteristically different effects prior to death, and each acts differently on the three groups of stocks of *P. aurelia* and on certain other species of Paramecium. These substances play an important role in natural selection, for, when a stock that produces a toxic substance and a susceptible stock are grown together, the latter is soon completely killed off. III. *Heredity:* Some stocks contain only mating type I, others contain both mating types I and II. The latter condition appears in all hybrids between these two kinds of stocks. In backcrosses to the pure type I parent, the conditions in the two parental stocks segregate in a 1:1 ratio. In the F_2 generation, they segregate in a ratio of 3:1. Inheritance thus appears to follow simple Mendelian rules and to depend upon a single pair of micronuclear chromosomes. In one stock in which two other mating types (V and VI) occur, the inheritance ratio depends upon the temperature prevailing during the process of nuclear reorganization (at conjugation and immediately thereafter). In this case the genetic differences appear to depend on the macronuclei, not the micronuclei; and the type of macronucleus formed depends at least in part on environmental conditions at one stage in the life. Thereafter, the effects are inherited through many fissions until the macronucleus disintegrates.

The Bornean species of the myrtaceous genus Syzygium Gaertner: E. D. MERRILL. In modern times most botanists have considered *Eugenia* Linnaeus as a collective group, although various attempts have been made from time to time to establish generic segregates; approximately 2,500 binomials have been published. A compilation of data appertaining to endemism for various regions in the Old World tropics shows the following: British India (85 species, 53 per cent. endemic); Siam (90 species, 26 per cent. endemic); Indo-China (68 species, 47 per cent. endemic); China (49 species, 55 per cent. endemic); Malay Peninsula (141 species, 60 per cent. endemic); Java (70 species, 45 per cent. endemic); Philippines (182 species, 81 per cent. endemic); and New Guinea (117 species, 85 per cent. endemic). Within the *Eugenia* complex no less than 36 generic segregates have been proposed by this or that author since the genus was established in 1753. With the exception of *Syzygium* Gaertner and *Jambosa* de Condolle, these proposed segregates have not been recognized or adopted by other than the individuals who proposed them. Approaching our problem with a consideration of *Eugenia* Linn. *sensu latiore*, we find that it is possible and practicable to reduce the *Eugenia* complex by the recognition of two small generic segregates for certain Old World species, that *Syzygium* and *Jambosa* can not be distinguished by any single character or combination of characters; that *Eugenia* may properly be restricted to the American species, with a relatively few in the Old World tropics; and for the bulk of the Old World species *Syzygium* is the proper generic name, as this group can be distinguished from the New World *Eugenia* by definite flower, seed and inflorescence characters. The Bornean species now approximate 160 species, of which 45 representatives of *Syzygium* are described as new.

White River Artiodactyla: WILLIAM BERRYMAN SCOTT. The White River was the first of the Tertiary time divisions in which the Artiodactyla became the predominant type of mammals. Eight families of Artiodactyla have been defined in the White River beds, and six of these are extinct, having left no descendants behind them. The two families which are still in existence are, first, the peccaries or wild swine and, secondly, the camels, which for the remainder of the Tertiary period were one of the most abundant of the North American groups. Within the camels there were several distinct, more or less parallel, tribes or phyla, which ultimately led to the grotesque giraffe-like camels at one extreme, and the small, exceedingly slender, gazelle-like camels at the other. The six extinct families are all exceedingly bizarre creatures, which had incredibly small brains, a feature which no doubt was important in leading to their extinction. These families are described in the forthcoming monograph in considerable detail, and it has become possible to classify them in a satisfactory way.

Evidence for a logical sequence of roof types on Maya buildings at Piedras Negras: LINTON SATTERTHWAITE, JR. The Maya Indians were the most southeasterly of several groups of great temple builders in what is now Mexico and Guatemala. Apart from several beautiful architectural styles, not considered in the paper, the unique Maya contributions to Middle American architecture were the corbeled masonry vault as roof support and great ornamental towers or "combs" rising from the roofs. The earliest known Maya temples and palaces were roofed with thatch—that is, palm leaves laid like shingles on peaked wooden frames or trusses. Excavations of the University Museum, University of Pennsylvania, have shown that at Piedras Negras, Guatemala, a ruined Maya city, less than half were roofed with the masonry vault. Earlier buildings had been destroyed to make way for these vaulted buildings. Other evidence is referred to which indicates that the city grew to full size before vaulted roofs were introduced. During the work of the 1937 season, prosecuted with the aid of a grant from the American Philosophical Society, the ground plans of several temples of the pre-vault period were worked out. To become intelligible the plans require us to suppose that roof-combs once rose from the thick foundation masses forming the rear walls of the temple chambers. With these combs in place a nearly flat plastered concrete roof in turn becomes necessary for a probable reconstruction of the fallen roofs. Lacking the vault, these must have been supported on horizontal wooden beams. The paper discusses briefly the relative advantages and limitations of vaulted and beam-and-concrete roofs, their distributions and datings in Middle America and the elements of which they are composed. Evidence is presented for believing that at Piedras Negras all the structural principles, materials and techniques necessary for building beam-and-concrete roofs were known in early times when temple roofs were still being thatched. It is concluded that the Maya may have borrowed the beam-and-concrete roof from Mexican neighbors in early times; or that they may themselves have invented it, as well as the vault. In either case roof types probably first appeared in the Piedras Negras district in the order (1) thatch, (2) beam-and-concrete, (3) vault. In this order roofs became increasingly permanent and increasingly difficult and costly to build.

The excavation of Tell el-Kheleifeh (Ezion-geber) by the American School of Oriental Research: MILLAR BURROWS. The archeological survey of Transjordan by Nelson Glueck, director of the American School of Oriental Research at Jerusalem, showed that there was extensive copper mining and smelting in the Arabah during the Early Iron Age. This recalled the biblical account of commercial activities under Solomon, including the establishment of a seaport at Ezion-geber on the Red Sea. Iron Age pottery found at Tell el-Kheleifeh, near Aqabah, pointed to this as the site of Ezion-geber. Preliminary soundings were promising, and the American Philosophical Society awarded a grant for excavation, which Glueck carried on during March, April and May of this year. Remains of mud-brick buildings belonging to four periods of occupation, from before the time of Solomon down to the seventh or sixth century B.C., were uncovered, including an elaborate copper refining plant, with extraordinary flues and drafts. Small finds indicate that the manufacture of copper and iron implements was practised also. Imported objects attest the active commerce by ship and caravan for which this port was a center. Further witness of commercial relations is borne by a jar inscribed with South Arabian characters. An Edomite inscription on a jug and eleven impressions of the seal of "Qaus-'anal, servant of the king," on jar-handles of the seventh or sixth century B.C. were found. The pottery, while related to that of the Early Iron Age in Palestine and more closely to the Edomite pottery hitherto found in Transjordan, is in some respects distinctive. Ledge and horn handles, not elsewhere found in this period, are especially characteristic. About two thirds of the mound, including the highest part, remain to be excavated. A second campaign is planned for next spring, if possible.

The Ihyā' 'Ulūm al-Dīn of al-Ghazzāli: NABIH AMIN FARIS. The *Ihyā' 'Ulūm al-Dīn* is the *magnum opus* of al-Ghazzāli, the greatest Moslem theologian after Muhammad and one of the noblest and most original thinkers of all time. He may be likened to Thomas Aquinas, whom he influenced, but his personal contribution to the theology was more considerable than that of Aquinas. He also influenced Pascal and left his impress on Christian and Jewish scholasticism in general. The *Ihyā' 'Ulūm al-Dīn* consists of four large volumes and contains more than a thousand closely transcribed manuscript pages of the folio size. The first two volumes treat of the outward forms of worship, while the last two deal with the inward nature of religion. In it al-Ghazzāli grafts mysticism onto Islam and establishes its orthodoxy. For this reason he has been called the St. Augustine of Islam. Through this book al-Ghazzāli led the Moslems back from scholastic labors upon theological dogmas and minutiae to living contact with the Word. Through it he insured for Sufism a firm and permanent position in the "Church" of Islam. Above all, through it he brought philosophy and philosophical theology within the range of the ordinary man. The unique position which it occupies among the Moslems is summed up by the words of Hājji Khalifah, the foremost Turkish writer of the seventeenth century, who said: "Should all other Moslem writings be destroyed, the *Ihyā'*, if spared, would make up for all the loss." Consequently, alongside of the ossified system of the traditionalists, the *Ihyā'* is earnestly studied; and in that study, without doubt, is the hope for the future of Islam.

Musical composition by American Moravians from 1742–1842: Albert G. Rau and Hans T. David. An appropriation from the Penrose Fund of the American Philosophical Society was made to the Moravian Seminary and College for Women, of Bethlehem, Pa., for the purpose of making a critical catalogue of original compositions by American Moravians during the one hundred years from 1742 to 1842. Out of a mass of two thousand or more manuscripts found in various Moravian churches in Pennsylvania, Maryland and North Carolina, we secured some four hundred that were original compositions made in this country by sundry Moravian musicians for the enrichment of the liturgical seasons of the church. Most of these are anthems for four or eight voices, with orchestral accompaniment of strings, with the addition also of wood wind and brass in some cases. Of the ten men whose works we examined, five were born on this continent. The obvious musical continuity in the series indicates a transfer of musical technique from the older to the younger workers in very evident fashion. Only a few of the works are secular, but these are extremely interesting. Among them is a series of Parthien or suites for wind instruments, obviously used for serenading purposes, and a group of six quintets for two violins, two violas and violoncello, which have been definitely determined to be the oldest compositions in sonata form composed in America.

SPECIAL ARTICLES

THE OCCURRENCE IN NATURE OF "EQUINE ENCEPHALOMYELITIS" IN THE RING-NECKED PHEASANT

Three pheasants were received for diagnosis on October 6, 1938, from a locality in Connecticut. These birds had been on range and were found in a more or less helpless or partially paralyzed condition and died before being shipped. The sender, Mr. Edward H. Mulliken, reported the finding of dead wild birds as well as pheasants following the hurricane of September 21. These pheasants presented no gross lesions, though the brain substance was rather soft. This was attributed to post-mortem change, the birds having been three days in transit. In view of the paresis that had been observed, the brain of each was inoculated into white Swiss mice intracerebrally in groups of 4 to 6, using large animals about six months old. All these mice were either dead or moribund on the fourth day, there being no noticeable difference in the course of the infection in any of the three groups.

A fourth pheasant was found sick in the same region and was received dead on October 18. There was a caseous mass around the gall bladder, which had evidently been ruptured. A suspension of the brain of this bird also killed large Swiss mice on intracerebral injection in from 4 to 5 days. This strain was carried through a second passage in mice.

Culture media inoculated with infective brain from mice of each of these groups furnished no growth either on gross or microscopic examination. The infection from one of these four pheasants was chosen arbitrarily for serial passage in mice. Young Swiss mice weighing 12 to 15 grams died in about 48 hours after intracerebral and in 3 to 4 days after intraperitoneal injection. Many of the animals developed a flaccid paralysis of the hind legs, though a few showed hyperexcitability. Occasionally a mouse, apparently well, would go into a convulsion, leap into the air and die a few minutes later after the manner of mice infected with herpes. This strain has been carried through 10 passages in mice. The titre of the virus in the brain is high; the intraperitoneal injection of 0.2 cc of a 1 to 10,000,000 dilution of infective mouse brain killed 1 of 6 mice. Guinea pigs, injected subcutaneously or intraperitoneally with a heavy suspension of infective mouse brain, died within 2 to 4½ days.

The course of the pheasant infection in mice and in guinea pigs presented characteristics which are strikingly similar to those of equine encephalomyelitis. Dr. Peter Olitsky, of the Rockefeller Institute, kindly supplied serum of a rabbit immune to eastern encephalomyelitis. Small amounts of this serum (0.1 cc) afforded complete protection to mice against 100,000 minimal infective doses of virus of the pheasant strain. The virus and serum were mixed and injected intraperitoneally, without preliminary incubation, into young Swiss mice (12 to 15 grams).

A few tests have been made of the susceptibility of other birds to the virus from the pheasant, using an inoculum of infective mouse brain. Two adult quail which were injected intracerebrally died after 4 and 5 days and the virus was recovered by the inoculation of brain tissue into mice. Of two injected subcutaneously, one died after 5 and the other after 10 days. Mice remained well following inoculation with the brain tissue of the quail dying after ten days. Therefore, the cause of death in this bird is doubtful. Fifteen newly hatched Rhode Island Red chicks were obtained. The virus was carried serially in these chicks through 4 passages, chiefly by subcutaneous injection. In the first and second passage all the chicks died, but in the third and fourth the course of the infection became progressively more uncertain. Six chicks injected intracerebrally died in about 48 hours; 9 were injected subcutaneously and 7 died at varying intervals. The virus was recovered by the intracerebral injection of mice with the brain tissue of a chick dying in the fourth passage after subcutaneous injection. The susceptibility of young chicks and of adult birds of other species makes entirely understandable the massive concentration of the virus of equine encephalomyelitis which develops in chick embryos as contrasted with the low titre of the virus in the brain of horses. The susceptibility of many birds to certain strains of encephalomyelitis has been demonstrated experimentally; notably the pigeon,[1] a species of vulture, the stork, the duck, the goose, the European blackbird and the common harrier of Europe.[2]

On preliminary study of stained sections of brain and cord of the pheasant infected in nature, perivascular lesions are found distributed unevenly throughout the cerebrum and there is also a meningitis. Around the small blood vessels there are prominent infiltrations composed of lymphocytes, plasma cells and large mononuclears. Cells of the same types occur in the pia. Polymorphonuclear cells are so rare as to be demonstrable with difficulty. The brains of inoculated quail and chickens show less conspicuous lesions. The cerebrum of the infected guinea pig presents numerous ill-defined foci of polymorphonuclear infiltration, distributed superficially in the brain substance. The lesions of the mouse brain are less obvious and are chiefly of a degenerative nature.

Summary: The recognition of a series of cases of equine encephalomyelitis in pheasants adds valuable information concerning the distribution of this disease, and the designation "equine" becomes an unfortunate misnomer. Indeed, it may be seriously questioned whether the horse or other domestic animals play any essential role in assuring the perpetuation of this disease. The present demonstration of the natural occurrence of the infection in game birds and the experimental evidence obtained by Remlinger and Bailly of the susceptibility of migratory birds to certain strains of encephalomyelitis suggest an easy mode for the wide distribution of this virus. A search for spontaneous infection in migratory birds is indicated. Extensive surveys will be required in order to know just how widely the infection is spread in nature. It may be only under accidental circumstances or when the infection rises to a certain level that it overflows and becomes a serious problem as regards the horse and even the human being.

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[1] L. T. Giltner and M. S. Shahan, SCIENCE, 1933, 78: 62, 1933.

[2] P. Remlinger and J. Bailly, *Compt. Rend. Soc. Biol.*, 120: 1067, 1935; *ibid.*, 121: 146, 1936; *ibid.*, 122: 518, 1936; *ibid.*, 123: 562, 1936.

THE ABSORPTION OF CARBON DIOXIDE IN PHOTOSYNTHESIS

IT is often stated that enzymatic processes are reversible. It is also a commonplace that photosynthesis is in many respects the reverse of respiration. Now there is every reason to believe that the CO_2 formed in oxidations arises from organic acids, probably by the same reactions as in fermentation, namely, from pyruvic acid by the action of carboxylase, from formic acid by the hydrogenlyase, from oxalacetic acid in its breakdown to pyruvic acid, from acetoacetic acid in the acetone fermentation, etc. What could be more natural than to suppose that in photosynthesis the absorption of carbon dioxide takes place in the reverse way, by combination with an aldehyde, or, more probably, with an organic acid, to produce a new carboxyl group? Specifically, a probable reaction is the combination of CO_2 with pyruvic acid to produce oxalacetic or perhaps with lactic acid to produce malic. The light reaction would then be the reduction, not of CO_2 as such, but of the carboxyl group.

This simple assumption would make the first reactions in photosynthesis much easier to comprehend. It is usually assumed, following Willstätter and Stoll, that the CO_2 combines with the chlorophyll, but for this there has never really been sufficient evidence. For formaldehyde ("activated" or otherwise) as the first reduction product of CO_2 there is even less evidence, and the persistence of these unsupported theories must be ascribed to the absence of any plausible substitute. It is hoped that the suggestion here made may provide a working hypothesis which at least is consistent with a number of facts.

Both in photosynthesis and chemosynthesis there is evidence pointing to such a reaction. In the *Athiorhodaceae*, in light, Gaffron[1] showed that CO_2 is absorbed in presence of mono- or di-carboxylic acids and there was a corresponding disappearance of carboxyl groups. In the *Propionibacteriaceae*, Wood and Werkman[2] have shown that CO_2 is absorbed, non-photosynthetically, probably by combination with an organic acid. The reversible equilibrium between CO_2, hydrogen and formic acid in *bacterium coli*[3] is also suggestive. Whether or no we may safely generalise from individual biochemical processes, it is a remarkable fact that recent work gives increasing evidence for the rôle of intermediate products themselves as catalysts or carriers in a catalytic cycle. There is the action of arginine in the formation of urea,[4] the dicarboxylic acid hydrogen carriers of Szent-Györgyi and co-workers[6] and the acetic-succinic-pyruvic-acetic cycle, while the cyclic processes of alcoholic and lactic fermentation are closely comparable. The combination of CO_2 with an organic acid, the photo-reduction of the carboxyl group and the consequent intramolecular changes leading finally to the setting free of the organic acid again, would be just such a cycle. Doubtless some of the organic acid would be reduced to sugar in each cycle.

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[1] H. Gaffron, *Biochem. Zeit.*, 260: 1, 1933; 275: 301, 1935.

[2] H. G. Wood and C. H. Werkman, *Biochem. Jour.*, 30: 48, 1936; 32: 1262, 1938.

[3] D. D. Woods, *Biochem. Jour.*, 30: 515, 1936.

[4] H. A. Krebs and K. Henseleit, *Zeit. Physiol. Chem.*, 210: 33, 1932.

These considerations suggest an important connection between photosynthesis and organic acid metabolism, a connection which, to the writer's knowledge, has never been investigated. If photosynthesis were to require a small supply of organic acid as intermediate, this would explain such observations as the failure of isolated chloroplasts to photosynthesize. In any event, it is believed that investigations along the above lines would be profitable.

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AIRPLANE COLLECTIONS OF SUGAR-BEET POLLEN

THE localized area in the Rio Grande Valley in southern New Mexico in which sugar beets were being grown for seed production in 1938 afforded opportunity for making collections to determine presence of sugar-beet pollen at various altitudes. The area planted to sugar beets for seed comprised about 900 acres and was concentrated into a few districts lying between El Paso, Texas, and Las Cruces, New Mexico. Source of the sugar-beet pollen caught was assignable with some sureness, since no other sugar beets were grown within a 125-mile radius. The period of flowering of the sugar beet extended from late April until the middle of June, the height of blooming being between May 15 and June 1.

Through the cooperation of the U. S. Army Air Corps an airplane flight in the general region of concentration of beet fields was made on June 3, 1938, by Major Guy Kirksey, commanding officer at Biggs Field, El Paso, Texas, with F. C. Meier as observer.[1] The flight was made from 10:30 A.M. to 1:00 P.M. of a hot, fairly quiet day. Series of short exposures of agar plates were made at the various altitudes.

Flights in other years in this region had indicated presence of sugar-beet pollen fairly high in the air.[2] Special precautions were taken in making the 1938 collections to eliminate possibility of contamination either prior to exposure or during examination of the agar plates. Using 40 per cent. sucrose agar, Petri dishes were prepared in Washington a few days previous to the flight. After solidification of the agar, the covers of the dishes were bound in place by a strip of Cellophane adhesive running across the lid and fastening to the bottom dish. The Petri dishes were also sealed with ordinary surgical adhesive tape to prevent contamination and drying. The small wooden Petri dish holder devised by F. C. Meier was used in exposing the agar plates outside the plane. This holder consists of a circular wooden base about the size of the Petri dish and is fitted with short projecting brass strips which, slipping between the overlapping side walls of the lid and base, clamp the bottom half snugly. In making an exposure the adhesive seal was removed in the cockpit, and the covered Petri dish pushed in place in the holder. The observer held the plate outside the plane with one hand, twisted the top with the other to cut the Cellophane binder and then removed the cover. When the exposure was completed, the lid was replaced outside the plane. The covered dish was then resealed with the surgical adhesive tape in the cockpit.

In order to avoid outside contamination, the exposed plates were taken directly from the landing field to an air-conditioned room for the examinations for presence of sugar-beet pollen. In the systematic study of the plates under the microscope, magnification with the 16-millimeter objective was ordinarily adequate for the identification. Magnification with the 4-millimeter objective to bring out more sharply the characteristic markings of sugar-beet pollen,[3] which differentiate it from allied pollens of somewhat similar size, was frequently used to verify identifications, and also whenever the pollen was more deeply embedded in the agar film. The data obtained from the examination of the plates for the various exposures are given in Table 1.

TABLE 1

SUGAR-BEET POLLEN GRAINS TRAPPED ON AGAR PLATES EXPOSED IN AIRPLANE FLIGHT, RIO GRANDE VALLEY, SOUTHERN NEW MEXICO, ON JUNE 3, 1938

Elevation above valley floor	Number of pollen grains and exposure period in minutes				
	1	2	3	4	5
1,000	–	17	19*	5	15†
2,000	–	–	14	4	7*
3,000	0	3*	7*	4	–
4,000	1 ; 0	0	–	2	6
5,000	5	2	6	6	9*

* One germinating pollen grain found.
† At least two pollen grains germinating.

Pollen grains were found at all altitudes with the number becoming fewer at four thousand feet. At the 5,000-foot level, which corresponds to the so-called "dust horizon," the number seemed appreciably larger than for the other altitudes except the lowest at which samples were taken. The plates showed also numerous fungus spores, plant hairs and pollen from other species of plants, notably *Pinus* spp. One pine pollen grain collected at 4,000 feet above the valley floor had germinated on the agar.

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[6] Zeit. Physiol. Chem., 236: 1, 20, 31, 58, 66, 1935.

[1] The senior author while continuing his research in aerobiology was lost with the Hawaii Clipper on July 29, 1938.

[2] G. H. Coons, U. S. Dept. Agr. Yearbook, 1936, p. 646.

[3] Ernst Artschwager and R. C. Starrett, *Jour. Agr. Res.*, 47: 823–843, 1933.

It seems at this time desirable merely to record the presence of viable sugar-beet pollen in the air at high elevations without any inferences as to relation to cross-pollination problems of the sugar beet.

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BASAL DIETS FOR VITAMIN B_1 DETERMINATION

Investigations which are still in progress have demonstrated that it is quite practical to prepare a diet satisfactory for the determination of vitamin B_1 by applying the observation of Williams and coworkers[1] that this vitamin is destroyed by cleavage with sulfite. A basal diet consisting of sucrose, 71 per cent., vitamin B_1 free casein, 18 per cent., salt mixture, 4 per cent., fat, 5 per cent., and cod liver oil, 2 per cent., was used, and various proportions of sucrose were replaced by addenda containing the vitamin B complex.

Sulfite treatment of yeast was carried out as follows: 400 cc of 0.1 per cent. sodium sulfite were added to 50 grams of dried yeast in a 500-cc wide mouth bottle. SO_2 was introduced until a pH of 4 was reached, and the bottle was then stoppered and allowed to stand 5 days at room temperature (25° C.). The contents of the bottle were then dried on purified casein at a temperature not exceeding 65° C.

Rats fed the basal ration containing 5 or 15 per cent. of sulfite-treated yeast, and receiving in addition crystalline vitamin B_1, grew as rapidly as animals receiving the same quantity of untreated yeast in the basal diet. Six animals 27 days old, weighing approximately 40 grams, were fed the basal ration with 15 per cent. of sulfite-treated yeast. Four of these animals developed acute polyneuritis in 32, 33, 34 and 34 days, respectively. Two animals died in 24 and 31 days, respectively, the latter showing slight symptoms of polyneuritis before death. There is reason to believe that with slight modification of the basal diet the percentage of polyneuritis can be increased and animals may be produced which are more suitable for quantitative assay where duration of cure of polyneuritis is used as the criterion.[2]

In the preparation of rations which contain adequate amounts of the members of the vitamin B complex and devoid of vitamin B_1, the destruction of vitamin B_1 with sulfite appears to offer definite advantages over any procedure that has been proposed. Details of an exact procedure are being studied, but because of a widespread interest at present in methods for determining the vitamin B_1 content of foods and pharmaceutical preparations as well as human requirements for vitamin B_1, this preliminary report may be helpful to others.

O. L. Kline
Chester D. Tolle
E. M. Nelson
Food and Drug Administration,
U. S. Department of Agriculture

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[1] R. R. Williams, R. E. Waterman, J. C. Keresztesy and E. R. Buchman, *Jour. Am. Chem. Soc.*, 57: 536, 1935.

[2] O. L. Kline, C. D. Tolle and E. M. Nelson, *Jour. Assoc. Off. Agric. Chem.*, 21: 305, 1938.

BOOKS RECEIVED

Actualites Scientifiques et Industrielles; Nutrition, 568, VIII, Les Régulations Hormonales du Métabolisme Gluoidique. Pp. 92. 20 fr.; *576, IX, Homéothermie et Thermorégulation, I, L'Homéothermie.* Pp. 70. 15 fr.; *577, II, La Thermorégulation.* Pp. 73. 15 fr.; *581, XI, Nutrition et Dentition.* Pp. 76. 20 fr.; *582, XII, Le Problème du Pain, III, La Qualité des Blés et Son Amélioration.* Pp. 43. 10 fr.; *594, Physiologie; 1, Glucides.* Pp. 66. 15 fr.; *2, Eau et Sels.* Pp. 27. 8 fr.; *3, Protides.* Pp. 54. 12 fr.; *4, Substances Nucléiniques.* Pp. 30. 8 fr.; *5, Créatine et Créatinine.* Pp. 40. 12 fr. Hermann, Paris.

Blair, G. W. Scott. *An Introduction to Industrial Rheology.* Pp. xiii + 143. 20 figures. Blakiston.

Bredereck, Hellmut and Robert Mittag. *Vitamine und Hormone und Ihre Technische Darstellung; Erster Teil, Ergebnisse der Vitamin- und Hormonforschung.* Pp. xii + 138. Hirzel, Leipzig.

Carmichael, Emmett B. *Laboratory Manual of Physiological Chemistry.* Pp. xxi + 126. University of Alabama. $2.10.

Imus, Henry A., John W. M. Rothney and Robert M. Bear. *An Evaluation of Visual Factors in Reading.* Pp. xiv + 144. 11 figures. Dartmouth College.

Madison, Harold L. *Wild Flowers of Ohio.* Pp. 190. Illustrated. Museum of Natural History, Cleveland. $1.50.

Science Reports of the Tôhoku Imperial University; Fourth Series (Biology), Vol. XIII, No. 2; October, 1938. Pp. 139. Illustrated. Maruzen, Tokyo.

Scientific Reports of the Australasian Antarctic Expedition, 1911–14; Freda Bage; *Vol. II, Part 6, Crustacea Decapoda.* Pp. 13. 1 plate. 3/. *Vol. II, Part 7, Cirripedia.* Pp. 14. 4 plates. 1 figure. 3/6d. Maurice Burton: Non-calcareous Sponges. Pp. 22. 1 figure. 3/6d. Government Printer, Sydney, Australia.

Scientific Reports of the John Murray Expedition, 1933–34; Vol. V, No. 4, by N. B. Eales, *A Systematic and Anatomical Account of the Opisthobranchia.* Pp. 122. 1 plate. 28 figures. 5/. Vol. V, No. 7, by J. Stanley Gardiner and Peggy Waugh, *The Flabellid and Turbinolid Corals.* Pp. 167–202. 7 plates. 6 figures. 5/. British Museum, London.

Stamp, L. Dudley. *Physical Geography and Geology.* Pp. vii + 256. 199 figures. Longmans, Green. $1.75.

Trudel, Walter. *Die Alamannen von Elgg, Eine anthropologische Untersuchung.* Pp. 114. 12 figures. G. Buchi, Zurich.

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THE AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE

PRELIMINARY ANNOUNCEMENT OF THE VIRGINIA MEETING

Edited by Dr. F. R. MOULTON

PERMANENT SECRETARY

FROM December 27 to 31, 1938, the association and about 35 of its affiliated societies will hold meetings in Richmond, Virginia. This is the one hundred third meeting of the association.

Richmond, the capital of Virginia, is a city of approximately 200,000 inhabitants. Not only is it a city of proud traditions, culture and education, but it is a center of industry and finance, being the seat of the Federal Reserve Bank of the Fifth District. Near its center is the Medical College of Virginia, a vigorous and rapidly expanding institution which last spring celebrated the one hundredth anniversary of its founding. In a suburb are the colleges for men and for women of the University of Richmond, and the College of William and Mary has a Richmond division. In addition, there are in this city a law school, a theological seminary and a university for colored students.

REGISTRATION

Registration will be in the Mosque, a magnificent recently constructed building within easy reach of all the hotels in Richmond and of each of the four groups of meeting rooms in which the scientific sessions will be held. The Mosque has splendidly appointed lounges, several rooms in which conferences and committees may meet and a restaurant which will be in operation during the meeting. The presidential address and the addresses delivered under the auspices of the Society of the Sigma Xi and the United Chapters of Phi Beta Kappa, as well as several other general addresses, will be delivered in the fine auditorium of the Mosque, which seats 4,500 persons. Moreover, the annual science exhibition of the association will be in the Mosque.

Hotels and Headquarters

General Headquarters: Jefferson Hotel.

Headquarters of the sections of the association and of the affiliated societies meeting in Richmond are as follows:

Jefferson Hotel: Sections on Geology and Geography (E), Botanical Sciences (G), Psychology (I), Social and Economic Sciences (K), Historical and Philological Sciences (L), Medical Sciences (N) and Subsection on Pharmacy, Agriculture (O), Education (Q), Botanical Society of America, American Phytopathological Society, American Society of Plant Physiologists, Mycological Society of America, American Fern Society, Sullivant Moss Society, American Society of Agronomy, American Society for Horticultural Science, Potato Association of America, American Psychiatric Association, Society of the Sigma Xi, United Chapters of Phi Beta Kappa, Sigma Delta Epsilon Graduate Women's Fraternity and National Social Science Honor Society Pi Gamma Mu.

John Marshall Hotel: Sections on Astronomy (D) and Anthropology (H), Society for Research on Meteorites, American Meteorological Society, American Association of Economic Entomologists, Entomological Society of America, American Nature Study Society, American Science Teachers Association and Gamma Alpha Graduate Scientific Fraternity.

Murphy Hotel: Section on Engineering (M), Ecological Society of America, Genetics Society of America, Limnological Society of America and Metric Association.

Richmond Hotel: Sections on Chemistry (C) and Subsection on Dentistry of the Section on Medical Sciences (N), Zoological Sciences (F), American Society of Zoologists, American Society of Parasitologists and American Society of Naturalists.

William Byrd Hotel: Section on Mathematics (A), American Mathematical Society, Mathematical Association of America and National Association of Biology Teachers.

Note: A local committee on housing, of which Mr. Foley F. Smith, A.B.C. Laboratory, Richmond, Va., is chairman, will assist visitors to secure satisfactory accommodations. Mr. Smith's committee will have an information desk at the Mosque and at each of the principal hotels during the first three days of the meeting.

Transportation

Richmond is on the through north and south route of both the Atlantic Coast Line and the Seaboard Air Line railways, which operate daily during the winter season such *de luxe* trains as the Orange Blossom Special, the Palmetto Limited, the Seaboard Florida Limited and the Havana Special. Richmond may be reached conveniently from western Virginia, North Carolina and South Carolina, and from Tennessee, Alabama, Mississippi and Louisiana by the Southern Railway System. Scientists from the West may go to Richmond via the Baltimore and Ohio Railroad or the Pennsylvania Railroad through Washington, or directly over the Chesapeake and Ohio lines. There are thirteen daily passenger trains each way between Washington and Richmond, which are only about one hundred miles apart. Altogether more than fifty passenger trains arrive in and depart from Richmond each day and more than seventy buses, while there is daily air service from both the north and the south to its municipal airport.

The railroads have not reached a decision respecting whether reduced rates will be in effect during the period of the meeting. Information respecting special holiday rates may be obtained from local railway representatives. At the present rate schedules, round-trip first-class fares to Richmond, exclusive of Pullman fares, from representative cities are as follows: Boston, $32.80; New York, $18.90; Philadelphia, $13.50; Baltimore, $7.80; Washington, $5.50; Atlanta, $27.20; New Orleans, $41.20; Cleveland, $31.60; Ann Arbor, $41.80; Columbus, $33.20; Indianapolis, $44.35; Chicago, $50.90; St. Louis, $56.95; San Francisco, $132.35.

Official Meetings

The Executive Committee, to which matters for the council are first submitted, will meet daily at 10:00 in the Salon of the Jefferson Hotel. The council of the association will meet at 2:00 o'clock on Tuesday, December 27, and thereafter daily at 9:00 A. M. in the Salon of the Jefferson Hotel. The council will elect a president and other officers of the association at its meeting on Friday morning, December 30.

The Academy Conference will be held on Tuesday at 4:00 in the Salon of the Jefferson Hotel. The conference will be followed by a complimentary dinner to official representatives of the affiliated academies and designated representatives of the association.

The Secretaries Conference will be held on Friday at 4:00 in the Salon of the Jefferson Hotel, followed by a complimentary dinner to the secretaries of the sections and of affiliated societies.

Annual Science Exhibition

The annual science exhibition, which will be conveniently housed in the Mosque, will include exhibits both of research laboratories and of manufacturers of scientific apparatus and equipment. The outstanding books on science published during 1937 will be on display and available for examination. Tickets of admittance to the science exhibition will be given to all registrants for the meeting. The Lounge of the Mosque, adjacent to the exhibits, will be found a convenient and attractive place for informal gatherings of scientists.

A school science fair by the high schools of Virginia will be held in the lobby of the Hotel Jefferson from Tuesday to Friday, inclusive. Cash prizes will be awarded for excellence of material and presentation. The fair is directed by Dr. Ira A. Updike, of Randolph-Macon College.

General Sessions

All evening sessions will be held in the Auditorium of the Mosque.

Tuesday, December 27. Address of the retiring president, Dr. George D. Birkhoff, on the subject "Intuition, Reason and Faith in Science." The Mosque, 8:15.

The address will be followed by a reception under the auspices of the Local Committee at the Jefferson Hotel.

Wednesday, December 28. Annual address under the joint auspices of the association and the Society of the Sigma Xi will be delivered by Dr. W. F. Durand on the subject, "Modern Trends in Air Transport." Mosque, 8:15.

At 9:30 in the same room Dr. David Sarnoff will deliver an address under the auspices of the association on some subject related to the social significance of modern means of communication.

Thursday, December 29. The annual address under the auspices of the United Chapters of Phi Beta Kappa will be delivered by Dr. Frank Pierrepont Graves on the subject, "Is Education a Science?" Mosque, 8:15.

"Virginia Homes and Gardens," by Dr. Wm. T. Sanger, president of the Medical College of Virginia, illustrated by slides, in natural colors, by Mr. Max Freydeck. Richmond Women's Club Auditorium, 4:00.

Sir Richard Gregory, distinguished scientist and editor of *Nature*, will deliver an address on the general subject of the effects of science on civilization, 8:15.

Friday, December 30. The concluding session of the symposium on Mental Health will be an address by Dr. C. Macfie Campbell on "Man's Behavior, Beliefs and Values as a Field for Systematic Investigation." Mosque, 8:15.

Saturday, December 31. "National Geographic Society Motion Pictures of Wild Animal Capture," by Dr. Wm. M. Mann, director of the National Zoological Park, Washington. Mosque, 10:30.

Breakfasts, Luncheons and Dinners

Tuesday, December 27

Dinners: American Meteorological Society, Ewarts Hotel. Section on Chemistry (C), Richmond Hotel. Section on Astronomy (D), Jefferson Hotel.

Wednesday, December 28

Breakfast: Pi Mu Epsilon, William Byrd Hotel.

Luncheons: Subsection on Dentistry, Rueger Hotel. Sigma Delta Epsilon, Ewarts Hotel.

Dinners: Entomologists, John Marshall Hotel. American Phytopathological Society, Jefferson Hotel. American Society of Plant Physiologists, Ewarts Hotel. Section on Psychology and Section on Education, Jefferson Hotel. American Society of Taxonomists, Jefferson Hotel. National Association of Biology Teachers, William Byrd Hotel. Ecological Society of America, Murphy Hotel. Biologists' Smoker, John Marshall Hotel.

Thursday, December 29

Breakfast: Sigma Delta Epsilon, Ewarts Hotel.

Luncheons: American Society of Parasitologists, Richmond Hotel. Genetics Society of America, Cabannis Hall, Medical College of Virginia. American Science Teachers Association, John Marshall Hotel. American Nature Study Society, Ewarts Hotel. Gamma Alpha, (place to be announced). The University of Chicago Botanical Alumni, Commonwealth Club.

Dinners: American Society of Zoologists, Richmond Hotel. Botanical Society of America, Jefferson Hotel. American Society for Horticultural Science, Commonwealth Club.

Friday, December 30

Luncheon: Pi Gamma Mu, Jefferson Hotel.

Dinners: American Society of Naturalists, John Marshall Hotel. Section on Anthropology (place to be announced).

Excursions and Short Trips

Historic Williamsburg. Excursions to Williamsburg have been arranged for Wednesday, Thursday and Friday. Buses will leave the John Marshall Hotel at 9 A.M. and will return by 5 P.M. The cost of transportation for the 100-mile trip, admissions to the exhibition buildings, official guides and luncheon will be $4.50 per person. Tickets will be on sale at the Mosque and at the information desks in all the principal hotels in Richmond.

Williamsburg, recently restored as perhaps the most interesting historic shrine in America, was settled as Middle Plantation in 1633, at the time only a palisaded barrier against the Indians. It became the capital of Virginia in 1699, its name being changed in honor of King William III, and remained the capital until 1799. In it is the College of William and Mary, founded in 1693 and the second oldest college in the United States. Jamestown, where in 1607 the English established the first permanent settlement in America, is only six miles away, while Yorktown, where the struggle for American independence ended in victory, is at a distance of only fifteen miles.

Tickets for the following industrial plant tours may be obtained from the Plant Tour Committee at the John Marshall Hotel. The tickets, 25 cents each, include transportation from the John Marshall Hotel to the industry and return. Additional special tours will be arranged.

The American Tobacco Company. Wednesday and Thursday at 10:00, 10:45, 11:30, 1:15, 2:00 and 3:00.

The company will open the doors of one of its air-conditioned factories, in which every stage of manufacture from the leaf to the finished product will be exhibited. Cigarettes will be produced at the rate of 10,000,000 an hour, the federal tax on which is $240,000 per day.

Southern Biscuit Company. Wednesday and Thursday at 10:00 and 2:00. The company operates a plant using the most modern methods in baking. Many of its products are from the famous recipes of Old Virginia, some of them dating back to 1847. The cakes and cookies under the trade symbol F.F.V. are known throughout America and a score of foreign countries. The exhibition will be olfactory as well as optical.

Home Brewing Company. Wednesday and Thursday at 10:00, 11:15, 1:15 and 2:15. The location of the plant has been the site of a brewery since 1865, having been chosen originally because of the famous Buchanan Spring on the property.

Virginia Electric Power Company. Thursday at 10:00 and 2:00. This modern plant will be of special interest because at the time of the meeting a topping turbine and related equipment will be taken down for its annual inspection.

SYMPOSIA AND JOINT SESSIONS

Section on Mathematics (A). On Wednesday morning the section will hold a joint session with the Section on Geology and Geography (E), the Mathematical Association of America and the American Mathematical Society at which the retiring chairman of the section, Professor W. D. Cairns, will deliver his vice-presidential address on "Seismology from the Mathematical Point of View."

Section on Chemistry (C). On Tuesday morning the section will present a symposium on "Reaction Rates in Organic Chemistry," on which papers will be delivered by Drs. Farrington Daniels, F. O. Rice, Gustav Egloff, Everett S. Wallis and Edward Mack, Jr. On Tuesday afternoon the section will present a symposium on "Natural Resins." The papers will be delivered by Drs. J. N. Borglin, Wm. Howlett Gardner and S. Palkin. On Wednesday morning the section will present a symposium on "Phenanthrene and Related Compounds." The papers will be by Drs. Harry Sobotka, Walter A. Jacobs, Lyndon F. Small, Erich Mosettig, Everett S. Wallis and R. E. Marker.

Section on Geology and Geography (E). On Tuesday morning the section will hold a joint session with the Geological Society of America and the Carolina Geological Society on "Geology of the Coastal Plain." On Tuesday afternoon the section will hold a joint session with the Section on Astronomy, the American Geophysical Union and the Geological Society of America on the "Importance of Geophysics to the Study of Continental Borders." On Wednesday morning, following the joint session with the Section on Mathematics, referred to above, the address of the retiring vice-president, Professor Kirtley F. Mather, will be delivered on the subject "Earth Structure and Earth Origin." On Wednesday afternoon the section will hold a joint session with the Geological Society of America and Carolina Geological Society on "Current Geological Research in the Piedmont and Central Appalachians." On Thursday morning the section will meet in joint session with the Society for Research on Meteorites and the Geological Society of America on "The Origin of the Carolina Bays."

American Society of Zoologists. On Wednesday afternoon the society joins with Genetics Society of America in a symposium on "Chromosome Structure." On Thursday morning the society will present a symposium on "Color Changes in Animals, their Significance and Activation," Dr. G. H. Parker presiding. The speakers will be Drs. G. H. Parker, H. B. Goodrich, A. A. Abramowitz, F. B. Sumner, D. C. Smith and F. A. Brown, Jr. On Friday morning the society will present a symposium on "Mating Types and their Interactions in Ciliate Infusoria; Determination, Inheritance and Relation to Sexuality," Dr. H. S. Jennings presiding. The speakers will be Drs. H. S. Jennings, T. M. Sonneborn, A. A. Giese, Lauren Gilman and Richard Kimball. On Friday afternoon the American Society of Naturalists, the American Society of Zoologists, the Botanical Society of America, the Genetics Society of America and the Section on Anthropology (H) will hold a joint session on "Contributions of Higher Animals to an Understanding of Human Biology." The papers will be by G. K. Noble, C. C. Little and Carl G. Hartman.

The Entomological Society of America, the American Association of Economic Entomologists and the Ecological Society of America will present a joint symposium on Tuesday afternoon on "Insect Populations," Dr. V. E. Shelford presiding.

Ecological Society of America and the Society of American Foresters will hold a joint session on Wednesday afternoon.

Limnological Society of America will present a symposium on "Some Leading Problems of Limnology, with Special Reference to Lakes."

Section on Botanical Sciences (G). On Wednesday afternoon the section will hold a joint session with its affiliated societies.

Botanical Society of America, American Society of Plant Physiologists and American Society for Horticultural Science will hold a joint session on Thursday morning.

Ecological Society of America and the general section of the Botanical Society of America will meet in joint session on Thursday afternoon.

Botanical Society of America and American Society of Naturalists and affiliated societies will meet in joint session on Friday afternoon.

Botanical Society of America, physiology section, and American Society of Plant Physiologists will hold a joint session on Friday morning on "The Physiology and Diseases of Cotton."

American Phytopathological Society and American Association of Economic Entomologists will hold a joint meeting on Thursday afternoon on "Problems of Regulatory Work."

American Phytopathological Society and Potato Association of America will meet in joint session on Friday morning on "Potato Disease Control." Among the speakers will be Drs. T. P. Dykstra, Donald Reddick, W. R. Mills, E. S. Schultz and J. G. Leach.

American Phytopathological Society and the floriculture section of the American Society for Horticultural Science will hold a joint session on Friday morning on "Disease Control of Ornamentals."

American Phytopathological Society and the Mycological Society of America will meet in joint session on Friday morning.

Section on Anthropology (*H*) will present a symposium on "The Archeology of the Atlantic Coast Area." On Friday afternoon the section will hold a joint session with the American Society of Naturalists, the general theme of discussion being the relation of the higher primates to human welfare.

Section on Psychology (*I*) and the Section on Education (Q) will hold a joint session on Wednesday afternoon.

Section on Historical and Philological Sciences (*L*) will present a symposium on Tuesday morning and afternoon on "The Centenary of the Cell Theory." The speakers will be Drs. E. G. Conklin, L. L. Woodruff, J. S. Karling, Franz Schrader and Paul Weiss.

Section on Medical Sciences (*N*) will present a symposium on "Mental Health" consisting of six sessions, mornings and afternoons, on Wednesday, Thursday and Friday, and a General Session on Friday evening. The chairmen of the six sessions will be Drs. Nolan D. C. Lewis, Abraham Myerson, Joseph Zubin, Harry Stack Sullivan, Clarence M. Hincks and Franklin G. Ebaugh. About fifty persons will present papers at the six sessions. The address at the General Session on Friday evening will be by Dr. C. Macfie Campbell on "Man's Behavior, Beliefs and Values as a Field of Systematic Investigation."

Subsection on Pharmacy of the Section on Medical Sciences will present a symposium on "Glycols." The speakers will be Drs. Frank C. Whitmore, H. O. Calvery, H. B. McClure, A. G. DuMez and H. B. Haag.

American Society for Horticultural Science and the Potato Association of America, affiliated with the Section on Agriculture (O), will hold a joint session on Wednesday afternoon.

Section on Education (*Q*) will present a symposium on "Problems of Interpretation of Educational Research," under the chairmanship of Dr. W. H. Bristow.

Section and Society Programs

Section on Mathematics (*A*). The section will hold a session on Wednesday morning jointly with the Section on Geology and Geography (E), the American Mathematical Society and the Mathematical Association of America, at which Professor W. D. Cairns will deliver his address as retiring vice-president of the association and chairman of the section on "Seismology from the Mathematical Point of View."

Section on Physics (*B*). On Friday evening Dr. Harvey Fletcher will deliver a demonstration-lecture as retiring vice-president of the association and chairman of the section on "Auditory Patterns."

Section on Chemistry (*C*). The program will consist of four sessions on Tuesday and Wednesday, the first three of which will be for the presentation of symposia (see foregoing report on symposia and joint sessions). In the first session on Tuesday morning Dr. Farrington Daniels will deliver his address as retiring vice-president of the association and chairman of the section on "Reaction Rates." The fourth session on Wednesday afternoon will consist of a round-table conference, led by Dr. Lewis W. Butz, on "A Systematic Nomenclature for the Saturated Hydrocarbons, from which Steroids are Derived and its Derivatives, with Special Regard to Stereoisomers and Synthetic New Steroids," and of five additional papers on various subjects by Drs. C. G. King, Hans Neurath; Albert H. Cooper, Carl D. Delamar and Henry Smith; J. E. Copenhaver and James F. Goggins, Jr., and Sister M. Lawrence and William Schiller. At the four sessions 20 papers will be presented in addition to the round-table conference. On Tuesday evening the section and its friends will join in a dinner in honor of Dr. Farrington Daniels, retiring chairman of the section.

Section on Geology and Geography (*E*) *and Affiliated Societies.* Of the six sessions of the section, which will be held on Tuesday, Wednesday and Thursday, the first five are joint meetings (see foregoing report on symposia and joint meetings) and the last on Thursday afternoon is devoted to "The Geography of Virginia and the Carolinas." On Wednesday morning Professor Kirtley F. Mather will deliver his address as retiring vice-president of the association and chairman of the section on "Earth Structure and Earth Origin," and addresses in honor of the memory of

William Barton Rogers will be delivered by Drs. Arthur C. Bevan and Joseph H. Roberts and probably others. With geologists, geographers, physicists, astronomers and seismologists participating in its sessions, the section presents a program which integrates to an exceptional degree related fields of science. At least 40 papers will be presented at the six sessions of the section and its cooperating section and societies.

The American Meteorological Society will meet Tuesday and Wednesday. Papers on meteorological service fifty years hence will be presented by President Robert E. Horton and W. C. Devereaux as a tribute to the late President Willis R. Gregg, who died in September. The first award of the Meisinger Aerological Research Fund prize will be made. Papers on hydrometeorology, air-mass analysis, aerology and the recent hurricane will feature the program.

Section on Zoological Sciences (F) and Affiliated Societies. No section has stronger or more active affiliated societies than has section F. Consequently, in order to serve most effectively the interests of zoology, the American Society of Zoologists, the Entomological Society of America, the American Association of Economic Entomologists, the American Society of Parasitologists and the Ecological Society of America organize the programs in the field of zoology.

The American Society of Zoologists will hold sessions on Wednesday, Thursday and Friday. The program on Wednesday morning will be presented in four sections: A. Experimental Embryology (10 papers). B. Endocrinology (12 papers). C. General Physiology (16 papers). D. Protozoology and Parasitology (11 papers). On Wednesday afternoon the society joins with Genetics Society of America in presenting a symposium on "Chromosome Structure." On Wednesday evening the society joins in the Biologists' Smoker. The program on Thursday morning will be presented in four sections: A. Symposium on "Color Changes in Animals, Their Significance and Activation" (6 papers). B. Endocrinology (continued; 14 papers). C. Cellular Physiology (12 papers). D. Experimental Embryology (10 papers). The annual business meeting of the society will be held on Thursday at 12:10. Thursday afternoon will consist of demonstrations as follows: Two 15-minute motion picture films, six demonstrations in cytology, four in embryology, three in physiology and endocrinology, and nine in general morphology and miscellaneous subjects. The Zoologists' Dinner will be held on Thursday evening. On Friday morning the program will be presented in four sections: A. Mating Types and their Interactions in Ciliate Infusoria; Determination, Inheritance and Relation to Sexuality (6 papers). B. Cytology and Histology (12 papers). C. General Physiology (13 papers). D. General Morphology and Miscellaneous (9 papers). On Friday noon there will be a Biologists' Luncheon. On Friday afternoon the society will meet in joint session with the American Society of Naturalists, Botanical Society of America, Genetics Society of America and the Section on Anthropology (H) for a program on "Contributions of Higher Animals to an Understanding of Human Biology." In addition to the 161 papers in the foregoing listed programs, there will be 98 papers read by title, 18 on Embryology, 19 on General Physiology, 11 on Cellular Physiology, 16 on Endocrinology, 11 on Cytology and Histology, 5 on Protozoology, 8 on Ecology and Parasitology and 10 on General Morphology.

The Entomological Society of America holds its thirty-third annual meeting on Tuesday, Wednesday and Thursday. On Tuesday afternoon it joins with other societies in a symposium on "Insect Populations" (see foregoing report on symposia and joint sessions). Dr. A. L. Melander will preside at the sessions of the society for the presentation of general papers. The society will join related societies in the annual Entomologists' Dinner, at which the annual address of the society will be delivered by Dr. C. T. Brues on "Food, Drink and Evolution."

The American Association of Economic Entomologists, in addition to participating in the symposium on "Insect Populations," will hold sessions on Monday, Tuesday, Wednesday, Thursday and Friday. On Monday the society will convene for two special conferences, the tobacco insect council and the pea aphis conference. On Tuesday there will be section meetings on apiculture, a continuation of the pea aphis conference and the teaching of entomology. The section on plant quarantine will meet all day on Wednesday and Thursday and the extension section will meet on Wednesday night.

The American Society of Parasitologists will hold sessions on Wednesday, Thursday and Friday. The principal feature on Thursday afternoon will be a demonstration program and a tea. On Thursday morning Dr. F. C. Bishopp will deliver an address on "Some Problems in Medical and Veterinary Entomology." A parasitologists' luncheon will be held on Thursday noon. The program, consisting of 67 papers and demonstrations, will be the largest in the history of the society.

Section on Botanical Sciences and Affiliated Societies. The sessions of the section and of its affiliated societies will be held on Tuesday, Wednesday, Thursday and Friday. On Wednesday afternoon, the section and its affiliated societies will hold a joint session (see foregoing report on symposia and joint sessions).

The Botanical Society of America will hold sessions on Wednesday, Thursday and Friday. On Thursday morning its physiological section will meet with the

American Society of Plant Physiologists and with the American Society for Horticultural Science; on Thursday afternoon the general section of the society will meet with the Ecological Society of America; and on Friday afternoon the society will meet with the American Society of Naturalists and affiliated societies. At the annual dinner for all botanists on Thursday evening, Dr. Edmund Ware Sinnott will deliver an address as retiring president of the society.

The American Phytopathological Society will hold its thirtieth meeting on Tuesday, Wednesday, Thursday and Friday. At a general session on Tuesday afternoon, Dr. C. W. Bennett will deliver an invitation paper on "Nomenclature of Plant Viruses" to be followed by a conference on the same subject and a conference on "Plant Disease Survey" in the evening. On Wednesday afternoon, the extension plant pathologists will hold a conference on "Methods of Seed Treatment," and the section will hold a joint session with the Section on Botanical Sciences and its affiliated societies. On Thursday afternoon the society will hold a joint session with the American Association of Economic Entomologists, and on Friday morning the society will hold a joint session with the Potato Association of America. On Friday the society will hold joint sessions with the Floriculture Section of the American Society for Horticultural Science and with the Mycological Society of America. A joint session is being planned with the Physiology Section of the Botanical Society of America and the American Society of Plant Physiologists on the "Physiology and Diseases of Cotton." In addition to the foregoing joint sessions, the society will hold a general session on Tuesday afternoon; three different sectional meetings on Wednesday morning on "Diseases of Fruits," "Diseases of Cereal Crops" and "Diseases of Vegetables"; and on Thursday morning three sectional meetings on "Forest Trees," "Tobacco" and "Miscellaneous Crops." A total of approximately one hundred papers will be presented on different phases of plant pathology.

The dinner of phytopathologists will be held on Wednesday evening.

The Mycological Society of America will meet on Wednesday, Thursday and Friday. On Wednesday morning the retiring president, Dr. L. O. Overholts, will deliver an address, after which short papers will be presented. On Wednesday afternoon the society will meet with other societies in the field of botany in a joint session, and with the American Phytopathological Society on Friday morning. The other sessions of the society will be dealing with such subjects as "The Taxonomy of Fungi," "The Effect of Growth-promoting Substances" and "The Parasitism of Man and Fish by Fungi." The society will join with related societies in their annual dinner.

The American Fern Society will hold a symposium on Saturday morning on "The Ferns of Virginia and Adjoining States."

Societies affiliated with Sections on Zoological Sciences and on Botanical Sciences. The Ecological Society of America, in addition to joining with other societies in a symposium on "Insect Populations" and holding a joint session with the Botanical Society of America and the Society of American Foresters (see foregoing report on symposia and joint sessions), has planned a field trip for Friday, and will hold its annual banquet on Wednesday evening, at which the presidential address will be delivered by Dr. H. C. Hanson.

The Genetics Society of America will hold sessions on Wednesday, Thursday and Friday. On Wednesday morning the program will consist of twenty demonstration papers and in the afternoon of a joint symposium with zoologists on "Chromosome Structure." The program on Thursday morning will consist of eighteen demonstration papers, a luncheon and business meeting at noon and an afternoon session, consisting of six invitation papers by Drs. M. L. Suche, D. R. Parker, M. Bishop, A. B. Griffen; A. Hollaender and C. W. Emmons; C. W. Metz and H. V. Crouse; W. P. Spencer; G. Fankhauser; and E. R. Sears. The program on Friday morning will consist of ten short papers and on Friday afternoon the society will meet in joint session with the American Society of Naturalists, the subject of discussion being "Contributions of Higher Animals to an Understanding of Human Biology." The contributors to the discussion will be Drs. G. K. Noble, C. C. Little and Carl G. Hartman.

The Limnological Society of America will hold its fourth annual meeting in conjunction with the association on Wednesday, Thursday and possibly Friday forenoon. In addition to two or three general sessions for the presentation of research papers, there will be a symposium on some leading problems of limnology with special reference to lakes. There will be nine or ten participants in the symposium and the research papers will be on such topics as limnological methods and apparatus, lake sedimentation, bacteria in natural waters, lakes of Argentina, and an invitation paper on sedimentation in reservoir lakes.

The Section on Anthropology (*H*) will hold sessions on Thursday and Friday. At the annual section dinner on Friday evening, Dr. John R. Swanton will deliver an address as retiring vice-president of the association and chairman of the section, on "Some Thoughts on the Problems of Progress and Decline." The section will present a symposium on "The Archeology of the Atlantic Coast region," and on Friday will hold a joint session with the American Society of Naturalists, the American Society of Zoologists, the Botanical Society of America and the Genetics Society of America. The general subject to be discussed in the joint session will be "The Relation of the Higher Primates to Human Welfare."

The Section on Psychology (*I*) will hold six separate program sessions on Tuesday, Wednesday and Thursday. The topics of experimental psychology, social psychology, animal psychology and abnormal psychology will be emphasized. The morning session on Tuesday, under the chairmanship of Dr. J. F. Dashiell, will consist of papers by Drs. William E. Galt, Jack Buel, W. J. Brogden, W. Horsley Gantt and Norman R. F. Maier. The Tuesday afternoon session, under the chairmanship of Dr. Calvin P. Stone, will consist of papers by Drs. G. H. S. Razran, Albert Ford and George F. Derr, John A. McGeoch, H. B. English and A. L. Edwards, Arnold Gesell and Wayne Dennis. The morning session on Wednesday will be devoted to a symposium under the chairmanship of E. A. Culler on the "Next Steps in Research in Audition." The speakers will be Drs. J. C. Steinberg, Don Lewis, Fred A. Mettler, E. H. Kemp, Heinrich Kobrak, Simon Dwarkin and Walter Hughson.

The afternoon session on Wednesday will be held in two sections, one under the chairmanship of Dr. Norman L. Munn, at which the speakers will be Drs. Frank A. Geldard, J. G. Beebe-Center, Richard S. Schultz, J. H. and C. P. Heinlein, Louis D. Goodfellow and David I. and Moses B. Macht. The other section will be a joint session with the Section on Education (see report of section), under the chairmanship of Dr. Frank A. Geldard. On Thursday morning one section will be under the chairmanship of Dr. John A. McGeoch, at which papers will be presented by Drs. George Lawton, Harriet Babcock, W. J. E. Crissy, A. S. Edwards, S. H. Epstein, Charles M. Discrens, Milton M. Parker, H. Rogosin and Ernst Harms. The other section of the Thursday morning session will be held under the chairmanship of Dr. J. G. Beebe-Center, and the speakers will be Drs. J. E. Greene, Stewart H. Britt, Elaine F. Kinder, Gladys McDermaid, Margaret B. Erb, Bernard F. Riess, H. Meltzer, J. E. Janney and John P. Shea. At the joint dinner of the section with the Section on Education, on Thursday evening, Dr. Calvin P. Stone will deliver his address as retiring vice-president of the association and chairman of the section on "The Significance of Individual Differences in Animal Psychology."

The Section on the Historical and Philological Sciences (*L*) will hold sessions on Tuesday and Wednesday morning. On Tuesday morning and afternoon the section will present a symposium on "The Centenary of the Cell Theory," at which the speakers will be Drs. E. G. Conklin, L. L. Woodruff, J. S. Karling, Franz Schrader and Paul Weiss. On Wednesday morning the section will hold a joint session with the Section on Mathematics, at which Dr. R. C. Archibald will deliver his address as retiring vice-president of the association and chairman of the section on "Mathematicians and Poetry and Drama."

Section on Medical Sciences (*N*). The program of the section consists of six sessions beginning on Wednesday morning and closing on Friday afternoon, all of which will be devoted to its symposium on "Mental Health" (see foregoing report on symposia and joint sessions). In connection with one of these sessions, Dr. Charles F. Code, winner of the Theobald Smith Award at the Ottawa meeting of the association, will present a paper on "The Blood Histamine in Normal and Certain Abnormal Conditions." At another session there will be a memorial address on the late Dr. Earl B. McKinley, to whom the section, as well as the entire association, is deeply indebted. On Friday evening the section will hold a general session, at which Dr. C. Macfie Campbell will deliver an address on "Man's Behavior, Beliefs and Values as a Field for Systematic Investigation."

The Subsection on Pharmacy of the section will present a symposium on "Glycols" on Tuesday morning, at which four invited papers will be presented by Drs. Frank C. Whitmore, H. O. Calvery, H. B. McClure and A. G. Du Mez, after which the discussion will be held by Dr. H. B. Haag.

The American Society for Horticultural Science will hold its thirty-fifth meeting on Wednesday, Thursday and Friday. In addition to various sectional meetings on plant breeding, general cultural problems of horticultural crops, tree fruits, small fruits, vegetable crops and floriculture and ornamental horticulture, there will be three joint sessions. The Vegetable Crops section will meet on Wednesday afternoon in joint session with the Potato Association of America. On Thursday morning there will be a joint session with the American Society of Plant Physiologists and the Physiology Section of the Botanical Society of America on "Low Temperature Injury to Plants." The section on Floriculture and Ornamental Horticulture will meet on Friday morning with the American Phytopathological Society. The annual banquet will be held on Thursday evening, December 29, at which time the retiring president, Dr. J. K. Shaw, will deliver the principal address.

Section on Education (*Q*). The section will hold sessions on Wednesday and Thursday. In addition to a program of general papers there will be special programs on "Problems in Reading," with Dr. Emmett A. Betts as chairman; on "New Developments in Education," with Dr. George D. Stoddard as chairman; and on "Economic Effects of Education," with Dr. W. G. Carr as chairman. There will be a session devoted to "Reports of National and State Surveys in Education." Dr. F. W. Reeves will report on the work of the President's Advisory Committee on Education, Dr. H. F. Alves on "State and Local Units in Ten States," and Walter C. Eells on "The Cooperative Study of Secondary School Standards." There will also be a report on the American Youth Commission. A symposium is being organized on "Problems of Interpretation of Educational Research," under the chairmanship of Dr. W. H. Bristow. There will be a round-table discussion on "Mental Hygiene in Education," led by Dr. Garry C. Myers. On Wednesday afternoon the section will hold a joint session with the Section on Psychology under the chairmanship of Dr. Frank A. Geldard, at which papers will be presented by Drs. Joseph Zubin, F. H. Lewis, F. P. Robinson, Henry F. Dickinson, Richard H. Henneman, Arnold Gesell and J. E. Greene and R. T. Osborne. At the joint dinner with the Section on Psychology on Wednesday evening, Dr. Ralph W. Tyler will deliver his address as retiring vice-president of the association and chairman of the section on "Basic Considerations in the Improvement of Educational Tests."

OTHER PROGRAMS

American Science Teachers' Association. On Wednesday evening the society will hold a dinner and conference, and on Thursday morning it will present a program of three papers, with Dr. W. L. Eikenberry presiding, the papers being by Dr. Philip R. White on plant physiology, Dr. Charles S. Piggot on the bottom of the ocean, and Dr. Harlan T. Stetson on solar activities. On Thursday the society will hold a luncheon, with Dr. Otis W. Caldwell presiding and Dr. Wesley C. Mitchell, president of the association, as its speaker. On Thursday afternoon the society will hold a session, Harry A. Carpenter presiding, in which Jerome Isenbarger, Hanor A. Webb and Karl F. Oerlein will speak.

The Sigma Delta Epsilon fraternity will hold a luncheon for members and guests on Wednesday noon.

The American Nature Study Society will hold meetings on Wednesday and Thursday. On Wednesday morning there will be a nature study program of miscellaneous topics, on which the speakers will be Drs. P. L. Ricker, Frank Thone and William A. Matheny. On Wednesday afternoon the subject will be "The Conservation of Wild Life." Dr. David E. Russell will deliver an address introductory to a panel discussion under the chairmanship of Dr. E. Laurence Palmer. The participants in the discussion will be Drs. Harry Cunningham, James W. McArthur, F. L. Ricker, Malvina Trussell, Charles Quaintance, C. W. Pomerat and Paul B. Sears. On Thursday morning the society will celebrate the thirtieth anniversary of its organization, the speakers being former presidents of the society. Dr. Edith Patch, presiding, will discuss "Looking Forward." Dr. Otis W. Caldwell will follow on "What Seems to be Ahead"; Dr. William G. Vinal, on "The New Nature Guide School of Massachusetts State College"; Dr. Morrison R. Van Cleve, on "In Defence of the Nature Study Idea"; Dr. George Rex Green, on "Teacher Training for Nature Study and Science"; Dr. Bertha Chapman Cady, on "A Northerner Looks at Nature in Tropical Florida"; Dr. Alfred Satterthwait, on "The Society and the Amateur"; and Dr. E. Laurence Palmer on "Cycles and Sequences in the Philosophy of Nature Study." On Thursday at one o'clock there will be a luncheon, at which Drs. Carroll Lane Fenton and F. R. Moulton will speak.

The seventeenth Annual Lecture presented under the joint auspices of the Society of the Sigma Xi and the association will be delivered on Wednesday evening by Dr. W. F. Durand on "Modern Trends in Air Transport."

The United Chapters of Phi Beta Kappa on Thursday evening will present the fourth of its series of annual lectures at a meeting of the association. The speaker will be Dr. Frank P. Graves on the subject, "Is Education a Science?"

SCIENTIFIC EVENTS

BIBLIOFILM SERVICE IN THE GEOLOGICAL SURVEY

To give research workers throughout the country access to further materials for their work, a Bibliofilm Service has been opened in the Library of the Geological Survey, Washington, D. C. Through the courtesy of Guy E. Mitchell, librarian, it is now possible for a scholar anywhere to have copied any properly copyable extracts from the quarter million books, journals and rare materials in the library, as well as many of its fifty thousand maps.

Bibliofilm Service is operated on a non-profit basis by the American Documentation Institute under a cooperative agreement with the Library of the U. S. Department of Agriculture, and also maintains copying installations in that library and in the Army Medical Library. It acts as a national clearing house for copying orders for research materials, filling them through its own and other services, for materials in substantially all Washington and Baltimore libraries, bureaus and institutions and in other cities here and abroad.

Copying is done in either of two forms microfilm (a series of still images on 35 mm standard safety photographic film comfortably usable in reading machines now widely available) at 1 cent per page, plus a fixed service charge of 20 cents, or in the form of photoprints (6 × 8 in. legible without optical aid) at 10 cents per page, plus service charge of 20 cents

Inquiry should be in the form of a definite order for the copying of specific materials, if available and properly copyable, the order will be filled Order blanks making a letter unnecessary are available free on request. Remittance must accompany order, or an amount of $5 or more may be sent to open the usual deposit account, which saves the necessity of remitting small sums. Information on reading machines may be obtained from Science Service, Washington, D C, who also supply a hand viewer invented by Dr Atherton Seidell, suitable for reading short extracts

The additional resources now opened to research workers everywhere, through Bibliofilm Service in the Geological Survey Library, comprise everything properly copyable among over 250 000 volumes, including geology, mining, paleontology, mineralogy chemistry, 50,000 geologic and other maps, United States and foreign, some 1,200 foreign and domestic periodicals and serials, including reports of State Surveys and Mining Bureaus, all governmental publications on the above subjects and the geological publications obtained by exchange from every foreign government. There are many surprising finds items not duplicated in any other American library, some exceedingly rare and useful aggregations

Remittance for copying material in the Geological Library, or material in other fields in other libraries, should be made payable to the American Documentation Institute, and all orders for copying should be mailed to Bibliofilm Service, care U S Department of Agriculture Library, Washington, D C

ESTABLISHMENT OF THE FRANK P BROWN MEDAL OF THE FRANKLIN INSTITUTE

THE Franklin Institute announces the establishment of a silver medal, to be known as the Frank P Brown Medal, to be awarded to "inventors for inventions and discoveries involving meritorious improvements in the building and allied industries." In a statement made by Dr Henry Butler Allen, secretary of the institute, speaking on behalf of the Board of Managers, he said that the expression "building and allied industries" is intended to include design and construction of buildings as well as appurtenant equipment within this industry

Mr Brown, who left the fund for this medal, was engaged in the plumbing business and metal manufacturing He became a member of the Franklin Institute in 1875. He served on the Committee on Science and the Arts from 1879 to 1910, was reelected in 1933 and continued a member until his death. He was chairman of the Jury on Lighting at the National Export Exposition conducted by the institute and the Commercial Museum in 1899

Medals which have been recommended and duly approved are awarded on "Medal Day," an annual event taking place in the month of May A subject may be investigated if the project is presented in writing to the secretary of the Committee on Science and the Arts, made up of leaders in the fields of engineering, physics, chemistry, astronomy, metallurgy and professional business men of established reputation Full and complete information must be submitted together with copies of such patents as may have been granted. If a careful and thorough preliminary examination of the matter discloses the subject to possess real value and to embody distinctly new principles, it is considered by a group of experts Should a favorable recommendation be made, the case, upon ratification by the committee, may subsequently be referred to a small group of specialists for thorough and searching study

In 1824, the year The Franklin Institute was founded, this committee was organized under the name of "Committee on Inventions," and its name was changed ten years later to "Committee on Science and the Arts" It has functioned without interruption for a period of one hundred and fourteen years, in the course of which it has passed upon upwards of 3,000 cases and has determined important awards. Among those who have been recipients of various medals are Alexander Graham Bell, Juan de la Cierva, Thomas A. Edison, Charles F Kettering, Guglielmo Marconi and Elmer A Sperry The medals under the jurisdiction of the group are the Franklin Medal, the Elliott Cresson Medal, the Howard N Potts Medal, the Louis Edward Levy Medal, the George R. Henderson Medal, the Walton Clark Medal, the John Price Wetherill Medal and the Edward Longstreth Medal A certificate of merit is also recommended by this committee

MEAD JOHNSON AND COMPANY "B-COMPLEX" AWARD

IN order to promote interest in researches dealing with the water-soluble "B-complex" vitamins, Mead Johnson and Company have established an annual award of $1,000 to be given over a period of five years through the medium of the American Institute of Nutrition. The institute, through an appropriate committee of judges selected from its membership, will name the recipient of this award, the formal presentation of it will be made as part of the program of the annual meeting held each spring.

The award will be given to the laboratory (non-clinical) or clinical research worker in the United States or Canada, who, in the opinion of the judges, has published during the previous calendar year, January 1 to December 31, the most meritorious scientific report dealing with the field of the "B-complex" vitamins. While the award will be given primarily for publication of specific papers, the judges will be given considerable latitude in the exercise of their function If in their judgment circumstances and justice so dictate, it may be recommended that the prize be divided between two or more persons. It may also be recommended that the award be made to a worker for valuable contributions over an extended period, but not necessarily representative of a given year Membership in the American Institute of Nutrition is not a requisite of eligibility for the award

To assist the committee of judges in its deliberations relative to this award, nominations are solicited for their consideration These may be sent any time to the secretary (undersigned) of the American Institute of Nutrition For a nomination to be considered for the award to be bestowed at any given spring meeting of the institute, however, it must be received by the secretary not later than January 15 The nomination should be accompanied by such data relative to the nominee and his research as will facilitate the task of the committee of judges in its consideration of the nomination

L A MAYNARD,
Secretary, American Institute of Nutrition
LABORATORY OF ANIMAL NUTRITION,
CORNELL UNIVERSITY,
ITHACA, NEW YORK

THE FIFTH INTERNATIONAL CONGRESS FOR THE UNITY OF SCIENCE AT HARVARD UNIVERSITY

THE fifth International Congress for the Unity of Science is to be held at Harvard University from September 5 to 10, 1939

The theme of the congress is "The Logic of Science", interest will center upon the relation of the concepts, laws and methods of the various sciences Attention will be devoted to general problems connected with the unification of science, and, in particular, with the logic of the physical sciences, the relation of the physical and biological sciences and the relation of the biological and socio-humanistic sciences. There will also be a number of special sessions and symposia concerned with special problems and fields.

The International Organizing Committee is composed of R. Carnap, P. Frank, J. Joergensen, C. W Morris, O. Neurath, H. Reichenbach, L. Rougier and L. S. Stebbing. The American Organizing Committee includes E. T. Bell, P. W. Bridgman, R. Carnap, A. Church, M. Cohen, J Dewey, H. Feigl, L. J. Henderson, C J Herrick, E. V Huntington, H. S Jennings, W Köhler, S K. Langer, C H. Langford, K. S Lashley, V F Lenzen, C I Lewis, R S Lillie, A. O Lovejoy, R M MacIver, W M Malisoff, W P Montague, C W Morris, E Nagel, F S C Northrop, W V Quine, H Reichenbach, E Sapir, G Sarton, H Schultz, E C Tolman, W Weaver and L. Wirth.

Professor P W Bridgman is the chairman and Dr W V Quine is the secretary of the committee on arrangements at Harvard University The congress is sponsored by the International Committee of the Congresses for the Unity of Science, by the International Institute for the Unity of Science, and, in America, by the American Association for the Advancement of Science, the Philosophy of Science Association, the Association for Symbolic Logic and the American Philosophical Association.

A series of twenty monographs, entitled "Foundations of the Unity of Science" (and constituting the first two volumes of the "International Encyclopedia of Unified Science"), is now being issued by the University of Chicago Press It helps to provide a background for the congress Three monographs have already appeared, and it is hoped that all twenty will be in print by the time of the opening of the congress.

Those who wish later notices of the congress are requested to send their names and address to Professor C W Morris, University of Chicago, Chicago, Illinois.

INSTALLATION OF THE FLORIDA CHAPTER OF THE SOCIETY OF SIGMA XI

THE Florida Chapter of the Society of the Sigma Xi, national honorary society fostering research in the sciences, was installed at the University of Florida, Gainesville, on October 28, by Dr Edward Ellery, of Union College, national secretary of the society

Dr Charles Carroll Brown, the oldest living past president of Sigma Xi, honored a luncheon by discussing the history and objectives of the society since it was founded in 1886 at Cornell University

The address of the day by the Honorable M. L. Wilson, Under-Secretary of the United States Department of Agriculture, commemorated installation of the chapter and at the same time celebrated fifty years of service by the Florida Agricultural Experiment Station. He praised the research work of the station in soil science, particularly in the field of minor minerals, plant disease and insect control, plant and animal nutrition, providing techniques and facts of service over a wide area. He also commended the principles of education fostered by the general college, which give broader training to students in keeping with the trend of modern times.

Dr. Ellery addressed members and guests at a banquet on "The Urge to Know." He pointed out that what is called form in these days of 1938 is an appreciation and acknowledgment and encouragement on the part of men everywhere of the irrepressible and irresistible urge to know, the eternal characteristic of human intelligence, always and inevitably pushing on into the unknown.

Officers of the newly installed chapter are: Dr. P. H. Senn, *president;* Dr. C. F. Byers, *vice-president;* Dr. R. B. Becker, *secretary,* and Dr. J. E. Hawkins, *treasurer.* The new chapter has 49 petitioners, whose membership in the national society was earned previously in chapters scattered widely over the United States.

TROPICAL MEDICINE

DR. ERNEST CARROLL FAUST, secretary of the American Academy of Tropical Medicine, writes that the fifth annual meeting of the academy was held on November 17 in Oklahoma City in conjunction with the American Society of Tropical Medicine and the Southern Medical Association. At the after-dinner program of the academy, of which Dr. Henry E. Meleney, of Vanderbilt University, acted as toastmaster, the presidential address, "Some of the Unsolved Problems in Research and Disease Control in the Tropics," was delivered by the retiring president, Colonel Joseph F. Siler, Army Medical School, Washington, D. C. Perry Burgess, president of the Leonard Wood Memorial, delivered a "Tribute to Dr. E. B. McKinley." At the business session the following officers were elected for the coming year:

President, William Walter Cort, the Johns Hopkins University.
Vice-president, Admiral C. S. Butler, Washington, D. C.
Secretary, Ernest Carroll Faust, Tulane University.
Treasurer, Thomas T. Mackie, New York City.
Councillor (5-year term), Herbert C. Clark, Gorgas Memorial Laboratory, Panama.
Councillor (1-year term), George W. Bachman, School of Tropical Medicine, San Juan, Puerto Rico.
Representative on the Council of the American Association for the Advancement of Science, Malcolm H. Soule.
Representative on the American Foundation for Tropical Medicine, Thomas T. Mackie.

The following were elected to active membership in the academy:

Dr. Justin Andrews, malariologist, Georgia State Board of Health.
Dr. George Dunham, lieutenant-colonel, U. S. A., Army Medical School, Washington, D. C.
Dr. Paul Hudson, professor of bacteriology, the Ohio State University.
Dr. L. L. Williams, senior surgeon in charge of malaria control, U. S. Public Health Service, Washington, D. C.

The American Society of Tropical Medicine met from November 15 to 18. The third Charles Franklin Craig Lecture on tropical medicine on "Progress in the Study of Infections Due to Bartonella and Rickettsia" was given by Dr. Richard P. Strong, and there was a symposium on "Newer Clinical Aspects of Deficiency Diseases," which was a joint session of the society with the Section on Medicine of the Southern Medical Association. The presidential address was delivered by Dr. Mark F. Boyd on "The Malaria Problem: Retrospect and Prospect." Officers elected for the year 1939 were:

President, Dr. Alfred C. Reed, San Francisco.
President-elect, Dr. L. L. Williams, Jr., Washington, D. C.
Vice-president, Dr. Sterling S. Cook, Norfolk, Va.
Secretary-treasurer, Dr. E. Harold Hinman, Wilson Dam, Ala.
Editor, Colonel Charles F. Craig, San Antonio, Texas.

New councilors, who were elected for a term of two years, are Dr. Mark F. Boyd and Dr. L. T. Coggeshall.

SCIENTIFIC NOTES AND NEWS

IN accordance with the recommendations made to the King of England by the Council of the Royal Society, London, Royal Medals have been awarded to Dr. Francis William Aston, F.R.S., in recognition of his discovery of the isotopes of non-radioactive elements, and to Professor Ronald Aylmer Fisher, F.R.S., in recognition of his contributions to the theory and practice of statistical methods.

ACCORDING to the *Bulletin* of the American Society for Testing Materials, L. F. Rader, associate professor of civil engineering at the Polytechnic Institute of Brooklyn, N. Y., has been awarded the prize of Belgium in a competition sponsored by the Permanent International Association of Road Congresses. This prize was founded by the Government of Belgium and is awarded at meetings of the congress to the author of the most striking paper submitted containing suggestions for promoting progress in construction, maintenance and exploitation of roads and for facilitating traffic. Dr. Rader's paper gave the results of investigations of the physical properties of asphalt pavements at low temperature.

THE Roebling Medal of the Mineralogical Society of America will be presented to Dr. Waldemar T.

Schaller, of the U. S. Geological Survey, at the annual meeting of the society to be held at the Waldorf-Astoria Hotel in New York City from December 28 to 30. Dr. Schaller is the second recipient of the medal.

DR. F. M. WHITACRE, assistant professor of organic chemistry at the Case School of Applied Science, was awarded the medal of the International College of Anesthetists at the annual meeting held in New York City on October 19. The award, which was made in recognition of his work on the chemical structure of anesthetics, consisted of a medal and a certificate naming Dr. Whitacre as a specialist in anesthesia and a fellow in the International College of Anesthetists.

AT the annual meeting of the National Society for the Prevention of Blindness, the Leslie Dana Gold Medal was presented to Dr. Elliee M. Alger, of New York City. This honor is given each year for "outstanding achievements in the prevention of blindness and the conservation of vision." The presentation was made by Dr. John N. Evans, of Brooklyn, on behalf of the Association for Research in Ophthalmology and of the St. Louis Society for the Blind. Dr. Alger and Lewis H. Carries, managing director of the National Society for the Prevention of Blindness, were the principal speakers.

DR. VANNEVAR BUSH, president-elect of the Carnegie Institution of Washington, D. C., will be the guest of honor on January 13 at the "All Engineers Dinner" given at the annual assembly of the American Engineering Council, which will be held in Washington on January 12, 13 and 14.

DR. F. J. SEAVER, of the New York Botanical Garden, has been elected an honorary member of the California Mycological Society.

DR. MORTIMER E. COOLEY, dean emeritus of the Colleges of Engineering and Architecture of the University of Michigan, has been elected a fellow of the Royal Society for the Encouragement of Arts, Manufactures and Commerce.

DONALD B. GILLIES, vice-president of the Republic Steel Corporation, has been elected president of the American Institute of Mining and Metallurgical Engineers. Four new directors have been chosen, as follows: Charles Camsell, Deputy Minister of Mines for Canada, Ottawa; Charles H. Fulton, president of the Southern Phosphate Company, Baltimore; John T. MacKenzie, chairman of the iron and steel division of the American Institute of Mining and Metallurgical Engineers, metallurgist and chief chemist of the American Cast Iron Pipe Company, Birmingham, Ala., and Dr. Francis A. Thompson, president of the Montana School of Mines, Butte, and chairman of the institute's mineral education division.

PROFESSOR KIRTLEY F. MATHER, professor of geology at Harvard University, who has been director of the Harvard Summer School since 1934, has been elected president of the Association of Summer School Deans and Directors.

DR. L. J. SPENCER was elected président of the British Mineralogical Society and editor of the *Journal* at the anniversary meeting of the society held on November 3.

DR. WILLIAM D. MERRELL, professor of botany since 1899 and member of the faculty at the University of Rochester, has been granted a year's leave of absence. He will retire from active service and will become emeritus professor in June, 1939.

DR. JOHN H. WHITTEN, of the Chicago Teachers College, has retired after serving for twenty-four years in the department of botany. The vacancy caused by his retirement has been filled by the appointment of Dr. Howard J. Dittmer, recently of the State University of Iowa.

DR. JOSEPH A. FREIBERG, associate professor, will succeed his father, Dr. Albert H. Freiberg, as head of the department of orthopedic surgery of the College of Medicine of the University of Cincinnati. The elder Dr. Freiberg resigned in July after forty years of service. Since then his son has been acting head.

AT the College of Arts and Pure Science of New York University, Dr. William H. Crew, of the United States Naval Academy Post-Graduate School, has been appointed chairman of the department of physics, and Dr. Ernest R. Lilley has been made director of the Geological Museum at University Heights. Dr. Edward R. Maloney, dermatologist, and Dr. Clarence E. de la Chapelle, heart specialist, have been advanced to full professorships in the College of Medicine.

THE following changes have been made in the faculty of chemistry of the Ohio State University: Dr. Albert L. Henne, formerly of the Midgley Foundation, has been elected to an associate professorship. Professor Henne will be associated with Professor C. E. Boord in the supervision and direction of the recently established Pure Hydrocarbon Research project of the American Petroleum Institute. Grant Crane (Dartmouth, '37) and Amos Turk (College of the City of New York, '37) have been elected to fellowships in this work. Through the establishment of a cooperative research plan between the Charles F. Kettering Foundation of Antioch College and the department of chemistry of the Ohio State University, Associate Professor Paul Rothemund, of Antioch College, has been elected non-resident associate professor in the faculty of chemistry of the university. John W. Van Cleve (Antioch College, '37), Amel Menotti (Antioch College, '37) and T. E. Londergan (Antioch College, '36) have been elected to Kettering Foundation fellowships with their research residence at Antioch College.

A CORRESPONDENT writes that the number of *Vita Universitaria* for October 5 contains a list of a hundred professors in Italy, eighty-five of whom were full professors, who were dismissed from their chairs as of October 16. The list includes: Bologna, Mario Camis; Genoa, Ugo Lombroso, and Milan, Carlo Foa, all professors of human physiology; Padua, Bruno Rossi, professor of experimental physics, and Tullio Terni, past fellow, professor of normal human anatomy; Palermo, Camillo Artom, professor of human physiology, and Emilio Segre, past fellow of experimental physics; Rome, Federigo Enriques, professor of higher geometry, and Tullio Levi Civita, professor of rational mechanics; Turin, Amedeo Herlitzka, professor of human physiology, and Giuseppe Levi, professor of normal human anatomy.

ACCORDING to the *Journal* of the American Medical Association a scientific advisory council has been appointed for the Children's Hospital Research Foundation at Cincinnati, Ohio. The council consists of Drs. Oswald T. Avery, of the Rockefeller Institute for Medical Research, New York; Ernest W. Goodpasture, professor of pathology, Vanderbilt University School of Medicine, Nashville, Tenn.; Albert Baird Hastings, professor of biological chemistry, Harvard University Medical School, and Alfred N. Richards, professor of pharmacology, University of Pennsylvania School of Medicine. The Children's Hospital Research Foundation was established in 1929 with funds given by Mr. William Cooper Procter. The hospital and the foundation are affiliated with the University of Cincinnati College of Medicine. Dr. Albert Graeme Mitchell, professor of pediatrics, is director of the medical service of the hospital and of the foundation. Dr. Glenn E. Cullen is director of laboratories.

DR. ARTHUR H. COMPTON, professor of physics at the University of Chicago, was inducted as Protestant co-chairman of the National Conference of Jews and Christians at a dinner of the New York Round Table of the conference on November 28 at the Hotel Astor, New York City. Dr. Compton succeeds the late Newton D. Baker as co-chairman. A bound volume of felicitations from more than three hundred American leaders was presented to him. Speakers at the dinner included: Lieut.-Governor-elect Charles Poletti; President Henry Noble MacCracken, of Vassar College; Matthew Woll, vice-president of the American Federation of Labor; Professor Harold C. Urey, of Columbia University, and Dr. Abraham Flexner, director of the Institute for Advanced Study, Princeton, N. J.

THE U. S. Bureau of Biological Survey has opened regional headquarters in Boston. Offices have been established in the Park Square Building with S. Barron Locke in charge as regional director. His jurisdiction will cover ten states, including New England, New York, Pennsylvania, New Jersey and Delaware. Bertram G. Smith, formerly in the office at Portland, has been appointed administrative assistant.

DR. PAUL C. BARTON, of Chicago, since 1934 a member of the staff of the Council on Pharmacy and Chemistry, has been appointed director of the Bureau of Investigation of the American Medical Association.

Nature states that Dr. T. S. Wheeler, principal of the Royal Institute of Science, Bombay, has left India and will shortly take up his new appointment as state chemist in Eire.

DR. J. A. VON MONROY, of Berlin, chief forester of Germany, is visiting the United States.

DR. CARL J. WIGGERS, professor of physiology of the School of Medicine of Western Reserve University, who left on September 9 for a lecture trip to South America, has returned to Cleveland. He sailed through the Panama Canal down the West Coast of South America, visiting Callao, Peru, Arica, Valparaiso and Santiago, Chile. Thence he flew over the Andes to Buenos Aires. In Argentina he was the guest of Professor B. A. Houssay, of the University of Buenos Aires, and of Professor Oscar Orias, of Santa Rosa, a former student in Cleveland. Dr. Wiggers delivered a series of lectures in Spanish on "The Applications of Physiology to Medicine" in Buenos Aires, Santa Rosa, Rosario and Cordoba.

A SERIES of Lowell lectures is being given in Boston by Dr. Arthur H. Compton, professor of physics at the University of Chicago, on "The Structure of the Physical World."

DR. W. F. G. SWANN, director of the Bartol Research Foundation, Swarthmore, Pa., spoke at the Industrial Science Banquet of the Iowa State College on November 22. His subject was "The Science of Yesterday, To-day and To-morrow."

DR. FRANK B. JEWETT, president of the Bell Telephone Laboratories, New York City, will speak at Rockford College on February 18 under the auspices of the William Arthur Maddox Foundation.

AT the annual meeting in Washington, D. C., of the American Society of Agronomy, which was held on November 16, 17 and 18, officers were elected for next year as follows: Dr. Ralph J. Garber, Bureau of Plant Industry, *president;* Dr. F. J. Alway, University of Minnesota, *vice-president;* Dr. W. A. Albrecht, University of Missouri, *chairman of the Soils Section;* Dr. F. D. Keim, University of Nebraska, *chairman of* *the Crops Section;* Professor J. D. Luckett, New York Agricultural Experiment Station, *editor;* and Dr. G. G. Pohlman, University of West Virginia, *secretary-treasurer.* Dr. R. J. Garber, Bureau of Plant Industry, and Dr. F. B. Smith, University of Florida, were elected to represent the society on the council of the American Association for the Advancement of Science in 1939. Officers of the Soil Science Society of America elected for next year are: Dr. W. A. Albrecht, University of Missouri, *president;* Dr. W. H. Pierre, Iowa State College, *secretary,* and Dr. G. G. Pohlman, University of West Virginia, *treasurer.*

THE third annual meeting of the Carolina Geological Society was held on November 12 and 13 with thirty-five members and twenty-six visitors in attendance. The meeting was held at the University of South Carolina. On November 12, there was a field trip of some 117 miles with twelve stops to examine the local geology about Columbia, S. C., both in the coastal plain and the Piedmont. The University of South Carolina gave the members a complimentary dinner. On November 13, there was an additional field trip of some 78 miles with five stops including the Haile Gold Mine near Kershaw, where refreshments were served. The field trips were arranged and directed by Professors Taber, Smith and Petty, of the University of South Carolina. The following officers were elected for the coming year: *President,* Professor L. L. Smith, University of South Carolina; *Vice-president,* Professor J. H. Watkins, The Citadel, Charleston, S. C.; *Secretary and Treasurer,* Professor Edward Willard Berry, Duke University; *Chairman of Membership Committee,* Professor Raymond Binford, Guilford College, N. C.

THE U. S. Civil Service Commission announces that the Department of Agriculture is in need of a number of principal chemists and principal chemical engineers at salaries of $5,600 a year. It is expected that the number will exceed twenty-five. Dr. Henry G. Knight, chief of the Bureau of Chemistry and Soils, suggests that all persons interested in these examinations communicate at once with the Civil Service Commission, Washington, D. C., in regard to the announcement containing the detailed information concerning the technical qualifications required. He urges all chemists having the technical qualifications to apply for this examination. Applicants will not be required to report for examination but will be rated on education, training and experience as shown on their applications. There is no obligation involved in taking the examination, although in view of the need for qualified persons it is hoped that it will be possible for an applicant to accept a position should one be tendered him. The list of eligibles from these examinations will be used for the appointment of project leaders in the four regional research laboratories being set up by the Department of Agriculture in accordance with an act of the last Congress. Work in the laboratories, each of which has an appropriation of a million dollars a year, will be based on the major farm commodities in the neighborhood of the laboratory.

THE St. Anthony Falls Hydraulic Laboratory of the University of Minnesota was dedicated on November 17. Dr. Guy Stanton Ford, the newly elected president of the university, presided. Among the speakers were Dr. S. C. Lind, dean of the Institute of Technology, and Corrington Gill, assistant administrator of the Works Progress Administration, Washington, D. C.

ADDITIONS to the present facilities of the Engineering Building at Rutgers University will increase the laboratory space available for engineering students by 6,242 square feet or about 57 per cent. The work will be started shortly and will be financed jointly by the university and the Works Progress Administration, which recently approved a grant of $34,576 for the project. The additions and alterations consist of two parts, one of which will provide for the construction of a new wing in the rear of the present building, and the other for reenforcing the floor over the swimming pool in the present Ballantine Building. This pool is the only unit remaining from the old Ballantine Gymnasium, which was destroyed by fire in 1930. The pool has been used by the department of engineering as a hydraulics laboratory since the present Ballantine Building was completed in 1932.

DISCUSSION

BEAVER-DAMS AS GEOLOGIC AGENTS

IN the mapping of the Schuylerville, Cohoes and Troy quadrangles of the Capital District and more recently of the Catskill quadrangle, the senior author had occasion to observe various broad and flat alluvial plains, affording rich farm-land, that in size are completely out of proportion to the small brooks that drain them at present. A typical case is the long, perfectly leveled valley east of Troy at the foot of the Rensselaer plateau, extending nine miles north and south and one-fourth to one-half mile wide. The origin of this partly "dead valley" is undoubtedly from glacial meltwater, as indicated by traces of terraces on the banks; but now it is drained by four different creeks, the Tomhannock, flowing north, the Quackenkill, flowing south, the Poestenkill, crossing it obliquely in the middle, and the Newfoundland creek, coming into it from the south. Another characteristic case is the Stony Creek alluvial plain, east of Madelin, near the southern margin of the Catskill quadrangle. This broad plain is 4 miles long and one-half to two miles wide and drained by creeks much too small to produce such a broad plain.

These alluvial plains are currently considered as post-glacial lake bottoms, but Mr. J. H. Cook, who has written the glacial chapters of the State Museum bulletins published by the senior author, has insisted that they were formed by brooks merely meandering over the plains and has given as proof that these plains are distinctly graded and descend with the brooks, a condition that seems irreconcilable with the lake origin. This is quite notable in the Stony Creek alluvial plain, where, according to the new topographic map now being published, the upper end is at 216 feet A. T. and the outlet at 164 feet. This would seem to exclude a former lake bottom, except when a slowly subsiding lake is assumed, which again fails to be supported by the presence of low terraces, and in the Troy valley the drainage running in opposite directions is distinctly hostile to such a view. Neither could have merely meandering brooks been able to produce the continuous Troy valley, indepepdent from the direction of the brooks.

For these reasons the senior author came to the conviction that a third agent had to be found and this is seen in the beavers who, by building dams successively upward from the lower reaches to the very sources of the creeks and repeating this process as often as the ponds are filled by sediment and carrying on the cycles of wandering up the creeks with dam-building for untold thousands of years (25,000 years are available in post-glacial time!), must have accomplished an enormous amount of aggrading work in the course of time in the northern half of North America. And if the giant beaver *Castoroides ohioensis,* of the size of a black bear, was also given to dam-building, which is not proven, even smaller river valleys could have been graded by its influence.

It is significant that the older settlers in parts of New York, as around the Tug Hill plateau (*fide* Dr. D. H. Newland) still know these alluvial valleys as "beaver-meadows."

Geologists apparently have overlooked this important geologic agent, a fact which is illustrated by the omission of the beavers as physiographic factors in Nevin M. Fenneman's authoritative "Physiography of Eastern United States," just published (McGraw-Hill Book Company, 1938).

The ceaseless activity of the beavers became very impressive to the senior author when he saw this summer how they, when driven by a flood from their dam below Cranberry Lake in Rensselaer County, repaired that dam and at once built a second above and started still a third dam a little farther up for the protection of the second. This wonderful industry is fully appreciated by the United States Government, as recently reported by the press; for it has set between 500 and 600 beavers to work in the northwest, notably Idaho, but also in Oregon, Washington, Utah and Wyoming, to stop erosion in brooks and creeks by importing beavers from regions where they are not needed, to the fast eroding waters and building there small provisory dams by CCC workers. The beavers as loyal government officials promptly complete work valued at $300 for each at a cost of $5.00 per head, according to a report by Mr. Ickes.

The junior author, who as assistant state zoologist has for many years studied the fascinating habits of the beavers in Rensselaer County, has undertaken to gather the following data on the present aggrading activities of the beavers in eastern New York. These data not only seem to illustrate the rapid work of the beavers, but above all the great width and height of the dams beavers can build on occasion and the size of the ponds they can form.

It seems reasonable to first consider the possible number of beavers that have inhabited the country and judging from such remains as beaver meadows and evidences of dams, it seems that every lake, pond, river and brook in New York State was occupied by this industrious rodent. Radford estimates that in the days of Champlain, the beavers in what is now New York State numbered probably several million and states that according to an old Dutch writer the Province of New Netherlands furnished eighty thousand beaver skins in the year 1671.

The next consideration might be the size of the dams and the area of the ponds. Mills records a Montana beaver dam that was 2,140 feet long. This, however, is extreme, and the junior author has found dams of fifty to two hundred feet to be more common and a six hundred-foot dam to be exceptional. Shiras writes that the left bank of what is now Echo Lake on Grand Island in Lake Superior is an ancient beaver dam 1,500 feet long and probably 400 years old. The dam which makes Beaver Lake in Yellowstone Park is about 700 feet long, and two dams described by Morgan are 488 and 551 feet in length.

The height of the dam is usually five or six feet, although the long Montana dam recorded by Mills was in two short sections, fourteen feet high, and Morgan described a dam 35 feet long and 12 feet in vertical height.

The bodies of water impounded by these dams vary in size. Warren reports that a 103-foot dam formed a pond 225 by 350 feet and a 165-foot dam flooded an area 340 by 800 feet. Three dams, 35, 50 and 60 feet long, respectively, formed ponds 350, 375 and 475 feet in length.

A dam 75 feet long is reported by Johnson to have backed up a mile of water, and Houk records 1,241 acre-feet of water impounded by beaver dams in the San Luis Valley, Colorado.

The number of dams on a stream is also an important factor in determining the size and shape of the beaver meadow and to locate six dams on a mile of stream is not uncommon. In fact, according to Houk, in Silver Creek Valley in Colorado there were 46 dams located on 5¾ miles of stream, and these averaged about 660 feet apart. In some cases the water was backed up to a depth of five and one-half feet.

So long as the beavers occupy the ponds no beaver meadows are formed, but as soon as the ponds are made the silt begins to settle in and fills them, and this forces the animals to continue to raise the dam. When the rodents abandon the pond, however, a meadow may be formed in a very short time.

In 1897 Seton mapped and described some ponds on Lost Creek in Yellowstone Park which were inhabited by a colony of beavers. These animals began to desert the area in 1903 or 1904, and in 1912 when Seton revisited the site the colony was abandoned and the meadows were pretty well formed. In 1921 the ground was solid and the dams practically obliterated. It is evident then that a meadow can be formed in about 15 years.

CONCLUSIONS

The authors, from the data presented here, conclude that beavers are able to aggrade all smaller valleys below the size of navigable rivers and having been active for many thousands of years have accomplished an enormous amount of aggrading work and are important physiographic agents. Their work is characterized by complete aggrading of valley floors, originally in small descending steps, which disappear in time and leave a gently graded, even valley plain horizontal from bank to bank. The fine silt gathered in the beaver pools has produced the rich farm land in the valleys of the wooded areas of the northern half of North America.

RUDOLF RUEDEMANN
W. J. SCHOONMAKER

NEW YORK STATE MUSEUM

THE MOVEMENT OF WATER FROM CONCENTRATED TO DILUTE SOLUTIONS THROUGH LIQUID MEMBRANES

AN experiment by W. J. V. Osterhout and J. W. Murray was described under the above title in the issue of May 13 of SCIENCE, page 430. To quote, "In certain models set up to imitate living cells the behavior of water is the opposite of what is expected, for it moves from a concentrated to a dilute solution or from a region of low to one of high activity. This apparent violation of the laws of thermodynamics may continue for months before equilibrium is attained." Briefly, this experiment consisted in using guaiacol (o-methoxy-phenol) as a membrane in the bottom of a U tube and placing water on one side and a solution of acetic acid in water on the other side. The water moves from the acetic acid to the pure water side.

In attempting to discover a possible thermodynamic explanation for the above experiment or to show that a thermodynamic explanation does not apply we have performed the following experiments. The freezing point of guaiacol was determined and the lowering in the freezing point was determined when water or acetic acid was added and finally when both were added simultaneously. It is found that water and acetic acid produce the same lowering of the freezing point when equal numbers of moles are added. This first experiment was not too conclusive, since the solubility of water is small in guaiacol. Three hundredths of a cubic centimeter of water was added to 50 cc of guaiacol. In the next experiment a large amount of acetic acid, 1 cc, was added to 50 cc of guaiacol, producing a lowering of 2.49 degrees. Addition of water to this solution in 0.1 cc quantities gave only one fourth the lowering which one would have predicted from the number of moles added. In this experiment there is no difficulty from small solubility, as water is quite soluble in this solution.

One may draw the conclusion from these experiments that the water and acetic acid are associated in the guaiacol solution. The fact that the water produces some lowering in the freezing point may indicate that the association is not complete or that acetic acid is associated by itself in guaiacol, and the addition of water increases the dissociation of double acetic acid molecules.

An explanation for at least part of the anomalous diffusion of water in the experiment of Osterhout and Murray may be as follows. Water and acetic acid are associated in water solution. This attracts no attention ordinarily, since the water is the solvent, but may be inferred from the fact that acetic acid, which exists associated as double molecules in the gas phase, exists as single molecules in water solution. The solute which is diffusing through the guaiacol is, therefore, this rather stable pair, which has been shown from the above freezing points to exist in the guaiacol solution. The diffusion of this pair is then a typical case of osmosis, except for the fact that the solvent is very slightly soluble in the membrane and the solute does the diffusing, from a region where its concentration is high to one in which its concentration is low.

This explanation serves to amplify the explanation given by Osterhout and Murray, who say that the phenomenon is due to the fact that the "acid increases the solubility of water in the guaiacol phase," indicates the way in which this increased solubility is brought about, does away with the apparent violation of the laws of thermodynamics, and suggests possible limitations in the applications of this model to biological phenomena.

HENRY E. BENT

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NATION-WIDE JUNIOR SCIENCE CLUBS

THE scientific attitude and scientific investigation have their beginnings in the lower grades of our secondary schools. Evidence of this appears in the desire of junior-high-school and high-school students to take part in scientific activities outside of regular school hours. The natural desire is to join a science club. Many of these science clubs are to-day well endowed in both leadership and facilities with which to work, so that they often make definite contributions to science. However, even before they finish their introductory work in science, secondary school students are being called upon to realize the application of scientific principles to every-day events, and to understand the position which science plays in the development of modern society.

During the past ten years, the American Institute of the City of New York has fostered the organization of its science clubs. This is a natural outgrowth of its efforts to relate science with society since 1828. Now, under the name of the American Institute Science and Engineering Clubs, it announces the expansion of its science clubs on a nation-wide basis to coordinate the scientific pursuits of American youth.

As a first step, the best youth organizations in the country have endorsed the plans. Already, educators everywhere are agreed that science is a natural and practical medium by means of which to stimulate and guide the thinking of young people. On October twenty-first, an introductory announcement of the new organization was sent to educators and their institutions, scientists, engineers and youth leaders, suggesting that they be sponsors of the clubs. This announcement presented the reasons for forming science clubs and explained how the American Institute Science and Engineering Clubs could perform the function of organizing existing and future clubs into one unit. The institute will supply upon request from these sponsors authoritative bulletins on "How to Organize a Science and Engineering Club," "How to Organize a Science Congress," "How to Equip a Science Techniques Shop" and "How to Interest a Community in Science Club Work."

As a unifying influence and also as a clearing house of science news for youth throughout the country, the American Institute will publish monthly its own science newspaper, called *The Science Observer*. This journal will carry columns devoted to club activities, youth research projects and up-to-date news in science. A pictorial section will be a feature of the publication.

The present program of the institute clubs calls for its annual science congress on December 29, at which the well-known Christmas lectures will be presented.

In March the annual science fair will be held in the American Museum of Natural History. To this come some of the most significant products of the scientific activities of the clubs and individual students. Four groups of exhibits designed to relate science with modern life are presented: Transportation, communication, production and public welfare are each a class under the engineering group. Plants and animals, medicine and biochemistry, heredity and evolution form the biological sciences. In the third group, the physical sciences, such as geology, astronomy and pure physics and chemistry, are represented. Of great interest will be the leisure-time activities exhibits of the fourth group. Prizes to a total of $3,000 are awarded to scores of exhibits at the fair.

Through the medium of traveling organizers, a speakers bureau and eventually short-wave radio, the work of the institute clubs will be organized as one national unit. Sponsors and other interested leaders may receive full information by writing to the American Institute, 60 East 42nd St., New York City.

C. A. FEDERER, JR.

OPPOSITION TO AN INTERNATIONAL CONGRESS OF PSYCHOLOGY IN VIENNA

WHEN the twelfth International Congress of Psychology, to be held in 1941, was awarded to Vienna, it was not supposed that within a few months Austria was to be annexed to Nazi Germany. The *Anschluss* took place on March 11, 1938. The reaction among American psychologists was immediate and unequivocal.

Six weeks after the *Anschluss* of Austria there occurred the annual meeting of the Midwestern Psychological Association at the University of Wisconsin on April 22. Resolutions were adopted after considerable discussion urging the removal of the 1941 congress away from Austria, because "Germany is now governed by a Nazi dictatorship, which has subordinated the integrity of science and of scientists to a political creed, which has caused the dismissal of many scientists and scholars from their positions, which has caused the emigration of many of the nation's outstanding scholars to other countries, and which has so injured German psychology that it no longer holds the eminent position it once did," and because "the attendance of the world's psychologists at an International Congress in Vienna could be interpreted at best as a lack of opposition to, and at worst an endorsement of Nazi treatment of science and of scientists."[1]

The Western Psychological Association, meeting at the University of Oregon on June 18, passed almost unanimously a resolution on the grounds that "psychology in Germany is no longer scientifically reputable." The Rocky Mountain Branch of the American Psychological Association followed with a resolution passed unanimously at its annual meeting at the University of Colorado on July 23, stating that "Austria is now ruled by a government whose philosophy is opposed to the free pursuit of science and whose treatment of many scientists has been uncivilized."

Three local psychological societies, in mail referenda of their membership, passed similar resolutions by majorities ranging from 89 per cent. to 100 per cent. The Chicago Psychological Club stated that "present-day conditions in Austria—restrictions on the freedom of teaching, speech, press and assembly; persecution of certain racial, religious and social groups; and stifling of the spirit of scientific inquiry—render many psychologists unable and unwilling to attend a . . . Congress of Psychology . . . scheduled to meet in Vienna. . . ." The Illinois Society of Consulting Psychologists requested that the congress "be convened in a location where every psychologist or guest, regardless of his ancestry, religious creed or political belief, may attend without fear of interference in his proper enjoyment of the Congress." The Psychologists League of New York City charged that the annexation of Vienna by the Nazi Reich "has produced in that city a reign of terror . . . with the connivance of the new governmental régime, and has . . . introduced . . . a situation that has long prevailed in Germany itself, where the free development of scientific psychology has been rendered impossible because, on the one hand, there has been official government support for patently unsound psychological theories that fit the political ideology of the existing régime, and, on the other hand, many individual psychologists of recognized probity have been driven into exile because they were Jewish or partly Jewish in ancestry or because they hold liberal political views, and that it is unthinkable that the decision to hold the Congress in Vienna could have been taken if it had been known that such a condition would prevail, since it is clearly impossible to have a true Congress of Psychology in a country that has driven into exile so many of the world's foremost psychologists, of whose scientific achievements any country might well be proud."

During September the American Psychological Association, together with three affiliated psychological societies, held annual meetings at the Ohio State University. The American Association for Applied Psychology, after receiving the council's report that "the council accepts the view that the association should take no action on purely political grounds but recognized that scientific work (even when of the purest research character) may have political reverberations and that political changes may have momentous effects on both pure and applied science. The association can not ignore the destructive influence of Nazi politics on all science, including our own. For the International Congress to meet in Vienna would be to take *political* action—political action favorable to anti-scientific forces. Psychologists in America, relatively remote from Nazi influences, have the duty to take the lead in withdrawing the Congress from its Vienna meeting place," passed unanimously the recommended resolution requesting a change of meeting place from Vienna, since "conditions have become unfavorable to the holding in that city of a scientific congress." The Society for the Psychological Study of Social Issues passed unanimously a resolution declaring that "many distinguished exiled psychologists would be unable safely to re-enter Nazi territory even for attendance at a scientific meeting" and that the actions of the Fascist dictatorship "violate the highest ideals of science." In the Psychometric Society, however, the council recommended that no action be taken on the ground that this matter did not concern the objective of the society, which is the "development of psychology as a quantitative rational science." A motion requesting removal of the congress from Vienna was subsequently laid on the table by a majority vote of the membership.

In the American Psychological Association, comprising about 2,500 psychologists, the following resolution as recommended by the council was received with applause by the membership and passed without dissenting vote: "*Be it resolved* that the American Psychological Association request the Committee in charge of arrangements for the XIIth International Congress of Psychology to terminate, if it has not already done so, the tentative plan to hold this congress in Vienna in 1941; and that it requests the committee to arrange for the congress in some country where the progress of psychology as a branch of science is not hindered by a government hostile to the tradition of free and unimpeded scholarship."

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[1] See SCIENCE, 87: 479, 1938.

Since the above-mentioned meetings of American psychologists it has been learned that the Council of the British Psychological Society has unanimously recommended the 1941 meeting of the congress be not held in Vienna.

The International Committee is comprised of 69 psychologists from all parts of the world. The executive committee is as follows: Edouard Claparède, of the University of Geneva, *permanent secretary;* Herbert S. Langfeld, of Princeton University, *secretary;* C. S. Myers, of the National Institute of Industrial Psychology, London, Henri Pieron, of the University of Paris, Mario Ponzo, of Rome, E. Rubin, of the University of Copenhagen, and Emilio Mira, of Barcelona, *members.*

CORRESPONDENT

SCIENTIFIC BOOKS

RESPIRATION

Adventures in Respiration. Modes of Asphyxiation and Methods of Resuscitation. By YANDELL HENDERSON. The Williams and Wilkins Company, Baltimore, Md. Pp. xi + 316, frontispiece, 15 figs. in text. June, 1938. $3.00.

IN 1905 Haldane and Priestley published a noteworthy paper on lung ventilation, ending with the well-known conclusion that "the regulation of the rate of alveolar ventilation in breathing depends, under normal conditions, exclusively on the CO_2 pressure in the respiratory center." These words had great weight with a young assistant professor of physiology in the Yale Medical School who was teaching his students that respiration is chiefly controlled by the vagus nerves and is relatively little influenced by oxygen or CO_2. The young man, Yandell Henderson, constituted himself "as an active propagandist for the Haldane doctrine, confident that the conception of CO_2 as a factor in the control of respiration must lead to a recognition of a similar part in the control of other functions as well, and particularly of the circulation."

During the next 15 years numerous papers came from the author's laboratory dealing with shock, respiratory regulation of the CO_2 capacity of the blood and hemato-respiratory functions. In "Adventures in Respiration" some attention is paid to venous return in relation to muscle tonus, but the principal thesis of the book and of the investigations just mentioned is that acapnia, or inadequate pulmonary ventilation, "is a factor in the depression of vitality after anesthesia, surgical operations, physical injuries and severe illness."

The 15-year campaign to win from fellow physiologists approval of his thesis of acapnia by laboratory experiment and theoretical discussions failed. We now know that in many respects Yandell Henderson was right and his critics wrong. In other respects, however, he was wrong, and the proof of his error was in some instances so convincing that the experimental foundations of his thesis were shaken.

At the end of the first campaign he shifted his attack to a front on which there had been but desultory firing. In 1909, before a distinguished gathering at Johns Hopkins, he had stated that administering 5 per cent. CO_2 in air or oxygen benefited apneic anesthetized animals. He suggested that medicine might advantageously adopt such mixtures for treating anoxial acidosis and he proposed that manufacturers prepare mixtures in cylinders for this purpose. This proposal brought such a devastating criticism from a distinguished professor of physiology in the audience that the speaker was left speechless; instead of a rebuttal, he offered good-humoredly to meet his critic outside.

In beginning his second 15-year campaign, Yandell Henderson decided to brush aside theoretical objections and to return to the attack on this neglected front. Here he very skilfully achieved victory. "Adventures in Respiration" records his success in persuading surgeons to provide their anesthetists with the CO_2-oxygen mixture, in teaching clinicians to use it in pneumonia, obstetricians in childbirth, and first-aid crews in resuscitation from carbon monoxide poisoning. The most dramatic success achieved has been in the treatment of carbon monoxide poisoning. An essential element in this is the H.H. inhalator designed by the author during the war and developed by the Mine Safety Appliances Company. It is estimated that the administration of CO_2-oxygen mixtures by means of this device saves annually more than 10,000 lives from carbon monoxide asphyxia in America alone. The treatment is also used abroad; it is officially sanctioned by the Mines Department of the British government.

Although brought up a physiological chemist, the author turns his back on biochemists. Their currently accepted idea of acid-base balance adds to his difficulty, and he finds a clear passage, "by steering contrary to their directions. . . . At critical points their latitude and longitude are erroneous, and even the points of the compass are reversed." While many will find other interpretations for his unhappy experience in attempting to follow the sailing directions of biochemists, none will dispute the eloquent confirmation he has given to the wise conclusion of Miescher that, "Over the oxygen supply of the body carbon dioxide spreads its protecting wings."

D. B. DILL

ATOMIC PHYSICS

An Outline of Atomic Physics. By O. H. BLACKWOOD, E. HUTCHISSON, T. H. OSGOOD, A. E. RUARK, W. N. ST. PETER, G. A. SCOTT, A. G. WORTHING; second edition, pages ix + 414, John Wiley and Sons, Inc., New York; Chapman and Hall, Ltd., London, 1937.

THIS volume, written by the members of the physics staff of the University of Pittsburgh, is designed as a text-book for those students who have completed one year of college physics and who, although desiring more knowledge of the subject, do not intend to specialize in it. The authors endeavor to acquaint the student with those branches of physics in which active progress is being made to-day, and to provide, at the same time, sufficient background to enable him to appreciate the significance of the more recent discoveries.

After a discussion of the atomic nature of matter and electricity, black-body radiation and the photoelectric effect are described to show the atomic nature of radiation. Then follow chapters dealing with the structure of atoms and molecules and their spectra. In this section there is attempted a reconciliation, or rather fusion, of the wave-like and corpuscular properties of matter and radiation by means of an introduction to wave mechanics and a discussion of the uncertainty principle. Although there are a number of points which might be criticized in this section, the degree of sophistication adopted is consistent with the remainder of the book, and is a very useful one.

There follow two chapters on nuclear physics, the first of which describes the natural radioactive elements and the properties of their radiations. The second chapter, which has been added in the second edition, contains an account of the discovery and properties of the neutron and the positive electron, the methods of producing charged particles of high energy and a survey of the artificial transmutations effected with them. Unfortunately, the chapter was written too soon to include any discussion of the concept of a compound nucleus, and no hint is given as to the origin of nuclear forces. Included also in this chapter are about twenty pages devoted to cosmic radiation. Here again the fact that the text antedates the discovery of heavy electrons somewhat mars the usefulness of the section.

The book is concluded by chapters on the theory of relativity and a long and very interesting survey of astrophysics. It is regrettable that physicists as a whole do not pay more attention to this important and fruitful field. The inclusion of it in this book is to be much commended. A surprisingly large amount of material is covered in this volume in a simple and straightforward manner. The style is remarkably uniform, considering the number of authors collaborating. The book should well serve the most useful function for which it was designed.

C. G. MONTGOMERY

BARTOL RESEARCH FOUNDATION OF THE
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THE MATHEMATICAL THEORY OF ELECTRICITY

Lectures on the Mathematical Theory of Electricity. By F. B. PIDDUCK. Oxford, The Clarendon Press, 1937. viii + 110 pp. $3.25.

THIS book is a series of fragmentary notes of a course of lectures which were themselves designed to supplement systematic reading by the student. It was evidently the author's chief aim to present in these lectures examples illustrating the application of certain formulae and methods of the theory to the solution of specific problems. Thus such problems as electrostatic shielding by plane and cylindrical grids, the space charge effect in thermionic vacuum tubes, the Aston mass spectrograph, the triod oscillator and the propagation of electromagnetic waves along wires are treated in adequate detail.

The book is of secondary value to an institutional reference library and may contain suggestive material useful to a teacher of the subject.

S. L. QUIMBY

COLUMBIA UNIVERSITY

STUDIES ON PTERIDOPHYTES

Manual of Pteridology. Edited by FR. VERDOORN. 640 pp., with 121 figures. Martinus Nijhoff, The Hague, 1938. Price, 24 guilders.

ACCORDING to its editor, "This book is primarily, but by no means exclusively, designed for the taxonomist who is anxious to improve his methods and broaden his outlook. At the same time it offers to the general botanist working on the Pteridophytes the necessary fundamental facts about the group, and a survey of the chief results of lines of investigation related to his own. . . . This manual is not, and never could be, an exhaustive monograph, it is rather a collection of essays. The editor has always urged his contributors to give more space to new ideas than to an academic summary of established knowledge. . . ."

The work comprises 23 chapters, covering a wide range of topics, some in English and some in German, written by the leading authorities on Pteridophytes. These essays furnish valuable summaries of the literature and discussions of the present state of our knowledge in the respective fields. Controversial subjects like the nature of the base of *Isoetes,* the tactic movements of spermatozoids and the phylogenetic relations between Bryophytes and Pteridophytes receive full and fair treatment. Especially noteworthy is a new classification of the *Filicinae* put forward by Christensen, on the basis of recent work on morphology.

Editing has been carefully done, and few misprints have escaped correction. Ample illustrations are included, and the printing and binding of the book are of high quality. Every institution where botanical research is carried on will need a copy in its library.

EDGAR T. WHERRY

SPECIAL ARTICLES

VENEZUELAN EQUINE ENCEPHALOMYELITIS

As is well known, severe epidemics of equine encephalomyelitis have occurred this year in Canada and the United States. A similar disease has now broken out in northern South America. Through the courtesy of the Ministry of Agriculture of the Venezuelan government and of Dr. Gunnar Tryde, of Caracas, we have received portions of brains of animals dying of this disease.

Virus has been recovered from these brains and preliminary observations have been made on the disease it produces in guinea pigs, mice and chicken embryos. The symptoms resemble those of Eastern encephalomyelitis. Nevertheless, it is clear that this virus is significantly different from either of the known American strains. Guinea pigs receiving it intracerebrally show first signs of paralysis after about 48 hours; they died in from three to five days. In young mice the disease follows a similar course. Guinea pigs can be infected by subcutaneous inoculation. Virus dropped onto the chorio-allantoic membrane of a developing chick embryo rapidly infects the entire embryo, which dies within a day. Brains of guinea pigs moribund with the Venezuela disease are especially rich in virus. Four that we have titrated have all been infectious for mice in a dilution of 10^{-7}. This indicates a virus concentration 10 to 100 times greater than that usually found in Eastern diseased brains. Several embryo-cultured virus preparations have had dilution end-points of 10^{-8}. They thus have contained about the same amount of virus as Western strain diseased embryos; Eastern strain embryos are ordinarily more infectious.

It has been shown[1] that formalinized virus vaccines will give solid immunity against corresponding forms of encephalomyelitis. We have made similar vaccines with Venezuela virus. All guinea pigs thus far vaccinated with them have successfully withstood the intracerebral injection of massive doses of Venezuelan virus.

Cross-protection tests have been made involving Venezuelan disease on the one hand and Western and Eastern encephalomyelitis on the other. Western strain vaccinated guinea pigs injected with Venezuelan virus have all succumbed with no evidence of protection. Eastern immune pigs diseased with Venezuelan virus have also all died, though in many instances a day or so later than unvaccinated controls. In a third experiment two groups of animals protected with the Venezuelan vaccine were given 10 to 100 m.l.d. of Eastern strain virus. They all died of encephalomyelitis, but those injected with the smaller dose outlived their controls.

These results demonstrate that our Venezuelan strain of encephalomyelitis is immunologically different from the familiar Eastern and Western forms of this disease. Though they are as yet insufficient to settle the question, they suggest that a remote relationship may exist between the Eastern and Venezuelan strains. No comparisons have been possible with the viruses of Borna's disease or of Russian encephalomyelitis. Work with the Venezuelan disease is being continued.

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[1] M. S. Shahan and L. T. Giltner, *Jour. Am. Vet. Med. Assoc.*, 84: 928, 1934; P. K. Olitsky and H. R. Cox, *Jour. Exp. Med.*, 63: 745, 1936; J. W. Beard, H. Finkelstein, W. C. Sealy and R. W. G. Wyckoff, Science, 87: 89 and 490, 1938; C. E. Beck and R. W. G. Wyckoff, Science, 88: 264, 1938; A. Eichhorn and R. W. G. Wyckoff, *Jour. Am. Vet. Med. Assoc.*, 46: 285, 1938.

THE PROTECTIVE EFFECT OF SULFANILAMIDE IN MICE AGAINST GONOCOCCAL "TOXIN"

Since sulfanilamide was first introduced for the treatment of gonococcal infections, we have been interested in the possibility that the favorable action of the drug might be concerned with the "toxin" of the gonococcus. Although the bactericidal effect of sulfanilamide *in vitro* has previously been demonstrated,[1,2] we have recently obtained an *in vitro* inactivation of gonococcal "toxin" with the compound.[3] Clinical data indicate that factors other than a direct effect of the drug on the gonococcus may contribute to its therapeutic efficacy. Thus, it is well known that certain patients recover with a minimal concentration of the drug in the tissues, while others fail to be cured when a high concentration is present. On the other hand, it has been frequently observed that the gonococcus is still present in infected areas after the symptoms have subsided subsequent to treatment with sulfanilamide. These facts point to an interaction of sulfanilamide with a gonococcal "toxin." Although some doubt has prevailed as to the existence of a substance which can rightly be termed a "toxin," our studies substantiate the findings of earlier investigators,[4,5] whose work indicates that a "toxin" is formed by the gonococcus.

By employing a technique similar to that described by Clark, Ferry and Steele[4] for the production of gonococcal "toxin," whole cultures, filtrates and supernates were prepared from several strains of the gonococcus which were fatal for mice in large doses. Because of the instability of these materials, the preparations were lyophilized by means of a Flosdorf-Mudd apparatus.[6] This procedure not only stabilized, but also concentrated the preparations, which were complex mixtures of metabolic products and autolysed cells. A regenerated lyophilized ascitic fluid broth culture of the gonococcus, containing no viable organisms, was employed in our studies. It is this type of preparation to which we give the name "toxin."

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[1] H. F. Wengatz, R. A. Boak and C. M. Carpenter, *Jour. of Bact.*, 35: 36, 1938.

[2] A. Cohn, *Am. Jour. Syph., Gonorr. and Ven. Diseases*, 22: 1, 1938.

[3] C. M. Carpenter, G. M. Barbour and P. L. Hawley, *Jour. of Bact.*, 36: 280, 1938.

[4] J. DeChristmas, *Ann. de l'Inst., Pasteur*, II: 609, 1897.

[5] L. T. Clark, N. S. Ferry and M. H. Steele, *Jour. Immunology*, 21: 233, 1931.

Although ascitic fluid broth cultures of several of our strains of the gonococcus killed mice, the results reported herewith concern only one particular strain, the "Le D." This strain was isolated during March, 1937, from the knee-joint of a patient with gonococcal arthritis.

After determining that the intraperitoneal injection of 0.2 cc of the regenerated lyophilized "toxin" killed mice (20 to 30 gm) consistently, a study was made of the relative toxicities and therapeutic values of various preparations of sulfanilamide. A 2 per cent. solution of the compound in 0.85 per cent. NaCl solution was found to be most satisfactory for our purposes. The sulfanilamide was administered intraperitoneally in two doses, one of 10 mg immediately after the injection of the "toxin" and a second of 20 mg 5 hours later.

After inoculation, the control mice usually died within 18 hours; a few lived longer than 24 hours. The coat became rough; the mice were listless and remained in a crouched position until death. Generally, diarrhoeae developed shortly after inoculation and the temperature became subnormal. The eyelids were often stuck together with a mucopurulent exudate.

The mice treated with sulfanilamide became cyanotic, ataxic or spastic and markedly opisthotonic. The reactions from the drug subsided in less than an hour, after which time the mice presented, to a lesser degree, some of the symptoms observed in the controls. When the drug became effective, the treated mice improved gradually, the majority recovering within 48 hours.

TABLE 1

THE THERAPEUTIC EFFECT OF SULFANILAMIDE IN MICE INOCULATED WITH GONOCOCCAL "TOXIN"

Group	No. of mice injected	Treated		Untreated	
		No.	Died	No.	Died
1 ..	15	10	0	5	5
2 ..	15	10	0	5	5
3 ..	13	9	0	4	4
4 ..	16	10	0	6	6
5 ..	8	5	0	0	3
6 ..	66	50	4	10	10
Total .	127	94	4 (4.3 per cent.)	33	33 (100 per cent.)

		Per cent. protected	Standard error
Summary	Mice with sulfanilamide .	95.7	± 2.1
	Mice without sulfanilamide	0	

Results obtained with intraperitoneal doses of 10 and 20 mg of sulfanilamide administered immediately and 5 hours, respectively, after the intraperitoneal injection of 0.2 cc of lyophilised and regenerated gonococcal "toxin" ("Le D" strain).

The results obtained by averaging 6 tests are given in Table 1. Six groups of mice were used in this particular study, the number of mice per group varying from 8 to 60. The total number was 127, of which 33 were controls. All the controls died within 24 hours. Only 4, or 4.3 per cent., of 94 treated mice failed to be protected. Of these, 2 lived for 4 days after treatment.

In summary, gonococcal "toxin" (a term used to describe the regenerated lyophilized ascitic fluid broth culture of the gonococcus, containing no viable cells, used in the present studies), which killed mice following its intraperitoneal injection, was produced from several strains of *Neisseria gonorrhoeae*. In the present report the results with one strain only, the "Le D," are described.

Mice injected with lethal amounts of the gonococcal "toxin" were protected from death by the administration of adequate therapeutic doses of sulfanilamide.

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THE FEASIBILITY OF PRESERVING NEOPLASTIC CELLS IN THE FROZEN STATE[1]

STUDIES on the resistance of single-celled or small multicellular animals and plants to extreme cold are reviewed by Heilbrunn,[2] who points out that survival after freezing may be due to factors which inhibit ice crystal formation. Ice crystals injure the cell both mechanically and by withdrawing water from the protoplasm. It is generally believed that slow freezing is associated with the formation of large crystals and is more injurious than rapid freezing.

Experiments on the resistance of the more labile neoplastic cells of mammals to freezing have yielded different results in the hands of different investigators. Carcinoma cells have been kept alive by Ehrlich[3] for two years at − 8° C. This temperature does not completely solidify the tissue. Ehrlich has also found that the growth of carcinoma cells is retained after exposure to − 30° C. for 48 hours. Michaelis[4] has successfully transplanted Jensen's tumor after it had been exposed to liquid air for a half hour. His observations have been confirmed by Moore and Walker[5] and Gaylord.[6] Little consideration has been given to the rate of freezing or thawing, and the tissues have not been kept in the frozen state for long periods.

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[6] E. W. Flosdorf and S. Mudd, *Jour. Immunology*, 29: 389, 1935.

[1] These investigations have been supported by the International Cancer Research Foundation, the Lady Tata Memorial Trust and a Fund for the Study of Leukemia.

[2] L. V. Heilbrunn, "An Outline of General Physiology," Philadelphia and London, W. B. Saunders Company, 1937.

[3] P. Ehrlich, *Zeitschr. f. Krebsf.*, 5: 65, 1907.

[4] L. Michaelis, *Med. Klin.*, 5: 204, 1905.

We have observed recently[7] that slow freezing is less injurious to neoplastic cells than is rapid freezing, and cells that were destroyed by rapid freezing survived slow freezing. At the time these observations were made, the authors were not aware of the similar results obtained by Rahn[8] with rotifers, nematodes and tardigrades. Rahn has found that these animals, in the active state, survived slow cooling to − 253° C. but were killed when frozen rapidly.

The rate of deterioration of neoplastic cells in the frozen state is very slow, and the results shown in Table I indicate that they can be stored for long periods at − 70° C.

TABLE I

RESULTS OF INOCULATIONS OF FROZEN AND THAWED MOUSE NEOPLASMS

Cell	Length of time kept at − 70° C.	Route of injection	No. of mice		Average incubation period	Average length of life after inoculation
			Inoculated	+		
	(days)				(days)	(days)
Lymphoid leukemia (Strain Akf 5)	8	s.c.	6	6	12	28
	86	s.c.	2	2	13	16
	147	s.c.	4	4	13	17
	440	i.v.,s.c.	4	4	15	25
Myelocytic leukemia (Strain Ar 117)	20	s.c.	7	5	19	42
	99	s.c.	6	5	17	58
	281	i.v.,s.c.	6	6	9	56
	440	s.c.	2	2	18	
Chloroleukemia (Strain S1b 351)	6	i.v.	4	1	24	42
	447	i.v.,s.c.	5	0		
	13	i.v.	4	1	21	36
	94	i.v.	5	0		
	1	i.v.,s.c.	5	4	14	25
Monocytic leukemia (Strain 82)	2	s.c.	4	4	14	23
	52	s.c.	4	3	13	20
	337	i.v.,s.c.	3	2	10	20
	430	i.v.,s.c.	4	3	15	25
Sarcoma (Strain S.3172)	1	s.c.	4	4	13	56
	151	s.c.	4	4	13	61
	448	s.c.	4	4	13	70
Carcinoma (Strain Afb 601)	2	s.c.	4	4	14	63
	98	s.c.	4	4	17	75

Abbreviations used in the table: s.c. = subcutaneously; i.v. = intravenously.

Technic: The tissue to be frozen was removed immediately after the animals were killed and was placed in a Petri dish on a chilled ice plate. It was minced with scissors in the presence of a small amount of Tyrode's solution. The minced tissue was distributed in small test-tubes (9 × 75 mm), approximately 0.5 cc in each, and the tubes were sealed with a blast lamp. The sealed tubes were immersed in alcohol at 0° C. and small pieces of solid C_2 were dropped in the alcohol at such a rate that the temperature dropped from 0° C. to − 70° C. during approximately one hour. The frozen tissue was stored under alcohol in a 12-gallon thermos bottle containing large pieces of solid CO_2. The tissues to be injected were thawed rapidly by shaking the tube in water at 37° C. This was found to be less injurious to the tissue than slow thawing.

Epithelium of chicken trachea was preserved in the frozen state in a similar manner. Many cilia were actively motile after 2, 16 and 327 days.

All strains of neoplasms tested could be preserved without difficulty except for the myeloid cells of a transmissible chloroleukemia (Strain S1b 351), but these, too, were found to resist freezing when large fragments of spleen, with no Tyrode's solution, were frozen.

The possibility that transmission by frozen cells is due to a virus present in the cells is very unlikely.[7] The results of an experiment suggested by W. A. Barnes are noteworthy in this connection. Cells irradiated while in the frozen state at − 70° C. with 4000 r of x-ray were completely inactivated. This dose of x-ray does not injure viruses at room temperature, and it is not likely to injure them at − 70° C.

Summary: All neoplastic cells so far tested could be preserved by freezing, and the virulence of those tested after a year at − 70° C. had not altered.

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[5] J. E. S. Moore and C. E. Walker, *Lancet*, 174: 226, 1908.

[6] H. R. Gaylord, *Jour. Infect. Dis.*, 5: 443, 1908.

[7] C. Breedis, W. Barnes, and J. Furth, *Proc. Soc. Exp. Biol. and Med.*, 36: 220, 1937.

[8] Rahn, quoted by Heilbrunn.[2]

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THE NEED OF INSULAR EXPLORATION AS ILLUSTRATED BY BIRDS[1]

By ROBERT CUSHMAN MURPHY

AMERICAN MUSEUM OF NATURAL HISTORY

I

IF the track of every civilized inquiring traveler could be accurately plotted on a globe, there is little doubt that all but a few small portions would become entirely black, due to the crossing and merging of the countless lines. This would apply to nearly the whole of the ocean as well as to the lesser area of continents and islands. In short, modern man has seen his world and has mapped with extraordinary faithfulness somewhat more than three quarters of it. The "unknown," in the geographic sense, has become exceedingly restricted. On the other hand, the little known still looms amazingly large. The fact that the scope of knowledge is so vast and human interest so diversified means that only a few centers of ripe culture have been studied in any large proportion of the aspects that man's curiosity makes possible. The great bulk of travelers add much to their own store of information and enjoyment; they may also exert a cumulative influence in the field of international relations. Few of them, however, can be expected to add new accretions to the sum of exact knowledge.

When a well-informed layman begins to acquaint himself with the biological material in a great museum, he is likely to conclude that the fauna of the world has been rather thoroughly collected, preserved, classified and filed, or in other words that the strictly pioneering part of the task of getting acquainted with the earth's inhabitants has been finished. For a few groups belonging to limited regions, such as the game mammals of the African grasslands, the birds of the British Isles or the fresh-water fishes of the United States, this may be substantially true. But with reference to very many other groups of living organisms, throughout expanses of the continents and oceans alike, the surface has not yet been even deeply scratched. Confining my own remarks to such a conspicuous and relatively well-known class of vertebrates as the birds, I am going to attempt to indicate the rich field for fundamental zoological investigation that still lies before museum men at islands scattered throughout the seven seas and their respective gulfs and bights. The opportunity applies scarcely less, indeed, to numberless small islets on the continental shelves, perhaps within sight of mainland shores, than to remote oceanic dots and archipelagoes lying at distances of hundreds of miles from the nearest extensive seacoast.

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[1] An address delivered before the Science Section of the American Association of Museums at the Academy of Natural Sciences of Philadelphia, May 20, 1938.

"The proof of the pudding is in the eating." In 1920 my own institution began a series of ornithological investigations in the Pacific, known collectively as the Whitney South Sea Expedition. For a decade or longer the schooner *France* was maintained as a base of operations. Before the craft was disposed of, and ever since that time, numerous less elaborately organized projects have been carried on continuously. The field of operations has extended from eastern Polynesia westward to New Zealand, New Guinea and its outliers and Micronesia. Let us consider briefly some of the scientific discoveries made in a region which had already been traversed by countless expeditions and visited by scores or hundreds of naturalists representing many nationalities since the birth of the modern age of scientific inquiry shortly after the middle of the eighteenth century. We shall draw our conclusions entirely from results which have thus far been published.[2]

The ornithological reports by six authorities, the majority of which are from the pen of my colleague, Dr. Ernst Mayr, reveal that up to May, 1938, 12 new genera and 196 new species and subspecies of birds have been described from the Whitney South Sea collections. This number is not unlikely to be doubled during the next few years, but no less important than the disclosing of hitherto unknown animals is the interpretative use to which they have been put. Among problems illuminated by the Whitney expedition, the following are some of those discussed in the publications cited:

Biogeographic phenomena of variation, including those exemplifying Bergmann's rule, *i.e.*, increase of size among closely related birds in direct ratio with higher latitudinal range; apparent evolutionary sequences as correlated with the distances between islands, the direction and force of prevailing winds, and other influences that bear upon obvious probabilities of dispersal and survival; the phenomenon of "swamping" or the breeding out of incipient races because of the ease and consequent frequency of repeated incursions from the populations of other island stations; detailed information on seasonal equatorward migration of certain south-temperate insular birds; distribution through primitive human agency; heterogynism, or the condition in which the diagnostic characters of species and races are exemplified chiefly or exclusively among females; other aspects of sexual dimorphism, including evolutionary reversal in its expression; physiology and genetics of plumage pattern in so far as conditions found in nature can be extrapolated from the data of experimental studies; marked disproportion in the normal relative numbers of the sexes; parallel evolutionary trends exemplified among the races of two or more species within a common genus.

II

"Case histories" offer, no doubt, the best basis for intelligible discussion. From a wealth of examples that are wide-spread in the Pacific—and, for that matter, at islands in other oceans—I shall choose certain warblers (Sylviidae) and flycatchers (Muscicapidae), endemic at the Marquesas Islands. Of the fifteen forms within these two families which inhabit all but one of the islands comprising the archipelago, twelve were made known to science by the Whitney expedition.[3]

Both of these groups of birds belong to widely distributed Old World families. The Marquesas have apparently derived their terrestrial biota, including the native human stock, from the southwest; warblers and flycatchers of the same or nearly related species still inhabit the Society and Tuamotu islands to southward. The subsidiary question as to the times, manner and order in which the birds first occupied nine of the ten islands in the rather remote Marquesas archipelago is more open to conjecture. However, the whole chain lies approximately along the axis of the steady southeast trade wind, and there are numerous indications that taxonomic interrelationship is largely in accord with the theoretical chances of island-to-island transfer.[4]

The warblers of the Marquesas are rather closely akin to the Eurasian and Australian reed-warblers (*Acrocephalus*). They are of the same species, in my opinion, as the warblers of the Society Islands (*Conopoderas caffra*), which lie roughly 800 geographic miles distant. Nine of the ten islands of the Marquesas are inhabited by these birds, and only two of the islands, namely, Hivaoa and Tahuata, which are very close together, share the same geographic race. Each of seven other islands has its own endemic subspecies, differing in size, hue or both from all the warblers of the neighboring islands. In one instance, two islands only a little more than three miles apart (Eiao and Hatutu) are occupied by faintly separate races, illustrating a fact which zoologists have been unduly slow to recognize, *i.e.*, that birds do not always undertake what their wings might make readily possible but that, on the contrary, slight barriers may demarcate for indefinite periods the ranges of closely related forms. Furthermore, it should be observed here that all these Marquesan warblers have exceptionally loose and fluffy plumage, quite unlike the feathering of the active, migratory reed-warblers of Europe. In any event, incipient differentiation is under way between the resident birds of Eiao and Hatutu; as to how much the process may have been inhibited by "swamping" or casual interchange of birds from island to island with consequent back-crossing and leveling, we can not even guess.

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[2] The data are recorded in the introduction and assembled papers of a volume entitled "Birds Collected During the Whitney South Sea Expedition, I–XXV" (articles from the *American Museum Novitates*, 1924–33), published by the American Museum of Natural History, November 6, 1933; also in additional numbers of the same journal (Whitney Expedition reports XXVI–XXXVII), 1933–38, as follows: Nos. 665, 666, 709, 714, 820, 828, 912, 915, 933, 939, 947, 977.

[3] These birds and certain related forms have been described and discussed by Murphy and Mathews, *Amer. Mus. Novit.*, No. 337, 1928, pp. 1–18.

[4] In this connection, Mayr has found that at Rennell Island, an isolated member of the Solomon group, the direction of the prevailing winds and the distance from neighboring archipelagoes are clearly correlated with the percentage of the several faunistic elements (*Amer. Mus. Novit.*, No. 486, 1931, p. 11).

Neither have we any means of knowing whether the warblers of Eiao and Hatutu would still be fertile *inter se* if they were brought together, but throughout the archipelago there is a clear correlation, as I have already hinted, between the taxonomic weight of several subspecies and the extent of spatial isolation. For example, the warbler inhabiting Motane Island, which is only ten miles from Hivaoa, is a "weak" subspecies, whereas the warbler of Fatuhiva, an island twenty-five miles from its nearest neighbor and "up wind" from the other islands, is the "strongest" or most highly distinctive race of the whole archipelago.

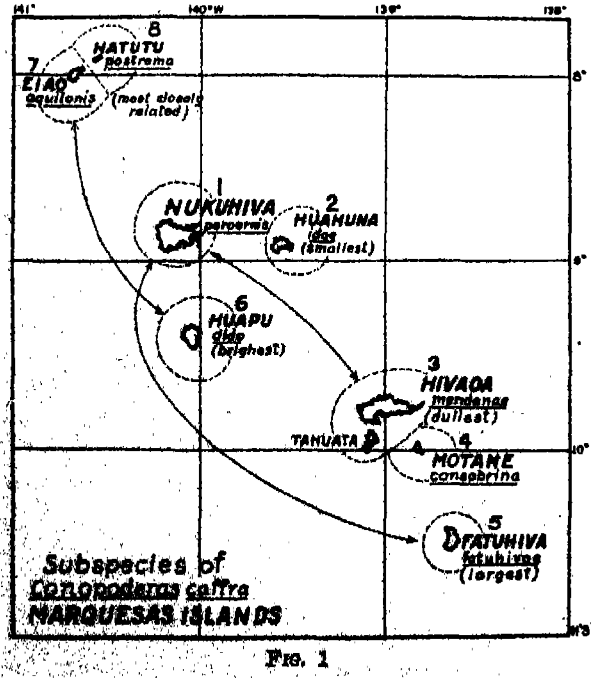

FIG. 1

In Fig. 1 I have allowed the mere subspecific names to stand for the eight warblers, because the birds are of such relatively uniform aspect except as regards the extremes in size that they do not lend themselves well to diagrammatic representation. The three double-headed arrows connecting islands or groups of islands indicate general resemblance or apparent relationship between subspecies, but systematic similarity is not necessarily the same as genetic heritage and no such sequential origin as might be suggested by the arrows can be accepted as established.

The eight Marquesan warblers, when torn from their scattered islands and laid side by side as specimens in a museum tray, comprise a close approximation of what is termed continuous variation. We can all but see intergradation, despite the insular setting. Certainly not one of the races is a notable "saltant," as compared with every other. The slight but constant differences are undoubtedly mutational and, needless to say, they have no conceivable causative relation to the environment. Nevertheless, the several island ranges are of necessity completely discontinuous. The dead birds lend no clue to a genetic interpretation of their characteristics, but surely we have no sound reason for assuming that the blood kinship of these forms is any closer, or their age as taxonomic entities necessarily any less, than that of the far more strikingly different flycatchers which occupy all but one of these same islands. If, as Dobzhansky writes, evolution is a modification of genetic equilibrium, and if mutations are the discontinuous steps in the continuous process of species formation, then the "microgeographic" differences among the warblers are due to different relative gene frequencies which, in such small and discrete populations, would be expected to fluctuate over a wide range of values.[5]

Turning now to the flycatchers (*Pomarea*), the diagrams in Fig. 2 stand for the seven Marquesan forms. Their distribution parallels that of the warblers, except that no flycatcher inhabits the northernmost island (Hatutu). Once again we find that the adjacent land areas of Hivaoa and Tahuata share the same form; that Motane has only a "weak" subspecies, closely resembling that of Hivaoa; that Fatuhiva in this instance also harbors the "strongest" and most distinctive of all these congeneric birds. In short, evidence for the isolation-speciation ratio accumulates.

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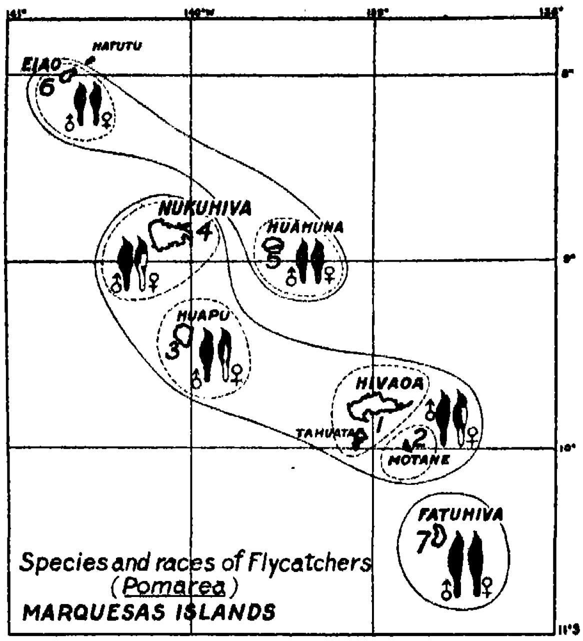
[5] Theodosius Dobzhansky, "Genetics and the Origin of Species," p. 180, 1937.



Species and races of Flycatchers (Pomarea) MARQUESAS ISLANDS

Fig. 2

The flycatchers, because of their marked differences in visible characters, have been described as three species, all endemic at the Marquesas, but they obviously comprise a single Formenkreis. Solid lines in the figure enclose the islands or groups of islands which are the homes of each species, broken lines those of each subspecies, the names of which may be identified from the numbers, as follows: (1) *Pomarea mendozae mendozae;* (2) *Pomarea mendozae motanensis;* (3) *Pomarea mendozae mira;* (4) *Pomarea mendozae nukuhivae;* (5) *Pomarea iphis iphis;* (6) *Pomarea iphis fluxa;* (7) *Pomarea whitneyi.*

In the diagrams of plumage pattern, white represents white, black is black, and ruled lines denote brown. In mature birds of one or the other sex among the seven forms there are therefore instances of an all-brown pattern, of a contrasting black-and-white pattern and of a saturated or all-black pattern. Minor variations include black streaks in the white areas of males belonging to the species *iphis* (5 and 6), and a brown wash on the breast of females in two races of the species *mendozae* (1 and 2). The group as a whole indicates a type of evolution which can hardly be thought of as slow, progressive and continuous. Most emphatically these flycatchers exemplify extreme discontinuity, in sharp contrast with the forms of *Conopoderas.*

Reduced to simplest terms, we find the following combinations of patterns among adult birds from north to south: *P. iphis:* brown or paedogenetic females, pied males; *P. mendozae:* pied females, black males; *P. whitneyi:* black males and females.

The sexes in *whitneyi* are indistinguishable. The species *mendozae,* of which there are four races, is heterogynous in that the subspecific characters appear only in females, the males of all being practically indistinguishable. As between the two species *mendozae* and *iphis,* there has been a partial reversal of secondary sexual characters, the females of the first of these exhibiting a pattern which pertains exclusively to males in the second. Finally, females of the species *iphis* have retained the youthful type of plumage worn by actually immature birds in every one of the seven Marquesan flycatchers, and which, it is not unreasonable to suppose, may typify the primitive or ancestral pattern of the whole assemblage.

Here, then, is something to bite upon, something to serve as a basis for logical interpretation. Within a single closely related group of animals "in the open," we find cock-feathered hens, hen-feathered cocks and immature-feathered hens!

All secondary sexual characters are either sex-linked or sex-limited, that is, the determinant gene lies either in the sex chromosome or in an autosome. In the latter circumstance the gene can express itself only in male or female "soil," as the case may be. Sex-limited characters are a natural result of chemical distinctions between the sexes. The effects of genes should be expected to differ in accordance with the different metabolic rates of male and female.

Thus the variation among these several flycatchers is capable of interpretation in either of two ways, one of which involves sex-linked mutations and the other hormonal control. The latter is more probable, judging by general experimental evidence from birds, but the alternative explanation can not be wholly ruled out as a hypothesis. In females of the species *Pomarea mendozae,* for example, the pied pattern may be either sex-linked in the W chromosome or sex-limited in an autosome. In males of this species the melanistic or saturated pattern may be determined by the Z chromosome and can appear only when two Z's are paired, for among birds, so far as known, it is the male which is homozygous for sex. In the case of *Pomarea whitneyi* we need assume only a familiar type of mutation which makes it possible for the melanistic character to appear when a single Z chromosome is present. We thus arrive at WZ ♀ and ZZ ♂, both black. The condition illustrated by *Pomarea iphis* might be explained by the crossing over of a female character to a male chromosome.

If, on the other hand, pattern determination among the Marquesan flycatchers is similar to that in poultry, male feathering represents the normal species plumage, while the female plumage is the result of inhibitory hormones. The basic condition might then be represented by a pied male and a brown female, as in 5 and 6 (*iphis*). Ovariectomy would cause such a female to become pied after the next molt.

The last statement is equivalent, however, to saying that influence of the female hormone lowered below a certain threshold would also produce pied females, a condition fulfilled in 1 to 4 (*mendozae*). The black males of *mendozae* could be similarly accounted for by a different hormonal threshold which permitted the pigmentation to go beyond piebald to black. The same situation, combined with a complete lack of female hormonal inhibition, would lead to case 7 (*whitneyi*), in which both sexes are black.

Such explanations are, of course, wholly genetic. Genes frequently act through controlling the rates of reaction; the effect of many mutations, as Goldschmidt[6] has pointed out, is to upset timing during development. A mutant gene may cause a certain "dosage" necessary for normal differentiation to be absent, or present only in a quantity below the necessary threshold. Such facts explain why the appearance of "maleness" in one form may denote "femaleness" in another.

If I seem to have gone into somewhat elaborate detail, it is because these two series of land birds, almost identical in their distribution throughout a small archipelago, present such an extraordinary assortment of the possible results within a limited gamut of biological variation. Furthermore, it should be emphasized that the distinctions within the respective genera represent great apparent differences in degree. The warblers (*Conopoderas*) are birds of common facies, their subspecific characters reflecting the sums of slight mutations which have affected chiefly size and color. The flycatchers (*Pomarea*), on the other hand, not only differ more greatly in size and proportions but also, without losing the clear stamp of common heritage, exhibit startlingly diverse plumage patterns, of both primitive and progressive types, which are, moreover, of the sorts that have been analyzed genetically with laboratory animals.

A population broken up into isolated colonies may differentiate mainly as the result of the restriction of its size. Even if the environment is homogeneous for all colonies, their selection and mutation rates the same and the initial composition identical, a sufficient passage of time will bring about a differentiation which need not be adaptive.[7] These Marquesan flycatchers, known thus far only as they exist in a discontinuous natural environment, do not constitute an altogether adequate genetic demonstration, in the strict sense, but surely the circumstantial evidence they present is too strong to be disregarded.

Islands offer, indeed, the closest approach in nature to the conditions of a man-controlled laboratory. They have one inherent advantage, of course, about which the experimenters can only speculate, namely, the presumably amassed influence of prolonged time. I am aware of no geographic reason as to why the ancestors of the warblers and flycatchers under consideration may not have occupied their respective Marquesan islets for, say, a hundred thousand years. Certainly the principle of complete isolation is often fulfilled at island groups throughout secular periods. The land birds that inhabit them are as a rule extremely sedentary so that transportation or "migration pressure" from one station to another occurs only as a result of exceptional agencies and at very long intervals. The oceans abound in instances of more or less adjacent islands occupied respectively by birds which differ from one another only by characters that might reasonably be ascribed to a single genetic factor. Among certain paired examples, indeed, it is almost obligatory to conclude that one of the two is a homozygote, preserved as such because imprisoned as a pure recessive in its insular "laboratory cage." Color mutants of familiar aspect are plentiful in the guise of endemic island races; flightlessness, comparable in skeletal and feather structure to that exhibited by many breeds of domestic fowl, has arisen among island birds of several orders where the absence of enemies lifts the penalty from such a trend; so-called "adaptive" radiation in the structure, and consequently the function (!), of a single organ, such as the bill, may almost parallel in families of island birds the monstrous mutations of bottle-grown fruit-flies. This is exemplified *par excellence* among the strange Hawaiian honey-creepers (Drepanididae) which have run their own complicated evolutionary course so long, and so far removed from the rest of the world, that the clues to their real phyletic affinities have become almost hopelessly obscured. To cite another somewhat comparable family of insular birds, it should be recalled that the famous "finches" of the Galápagos (Geospizidae) were perhaps the strongest particular influence in implanting the germ of the evolutionary idea in the mind of the youthful Darwin, who was impressed by the perfect gradation in the size of the beaks among the species of these curious birds.

III

I accept, in the main, the orthodox tenets regarding the processes of heritable variation which, after the all-important ingredient of *time* has been added, no doubt weave the infinite pattern of speciation in nature. So far as we certainly know, all inherited differences have arisen as mutations, and the example of the Marquesan flycatchers might serve to reconcile the points of view of the taxonomist and the student of genetics. Nevertheless, I want to indicate one or two remarkable cor-

[6] Richard Goldschmidt, "Physiological Genetics," 1938.

[7] Dobzhansky, *op. cit.*, p. 183.

relations frequently illustrated among island birds, in the attempt to account for which, so far as I am aware, neither an adequate genetic hypothesis nor a speculation as to the possible effect of the environment has ever been advanced.

One of these concerns the presence of some particular structural stamp shared by a more than chance proportion of island birds, regardless of their systematic affinities. The other relates to common or nearly universal characteristics that we sometimes encounter in practically all the forms of birds confined to a particular island. At Ninigo, northwest of the Admiralty group, Dr. Mayr has found that every one of a considerable number of endemic subspecies is larger and of darker coloration than the nearest related forms elsewhere. At Rennell, an outlier of the Solomons, the endemic subspecies show a pronounced tendency toward reduction in size; in fact, this island is the sole home of the smallest known races of many species of birds which are widely distributed throughout the Indo-Australian region. These facts can hardly be dismissed as coincidences. It is well known that representatives of various families, orders and even classes inhabiting a given geographical region often undergo convergent changes, for which specific biophysical reasons have been advanced.[8] But neither the adaptive "peaks" and "valleys" of Wright,[9] nor any mechanism independent of the environment appear to explain why mutations toward small size make the components of a varied population fittest to survive at Rennell.

Turning now to the question posed first above, it has long been recognized that island land birds are apt to have longer or more robust bills than their nearest continental representatives. Fortunately, the fourth edition of the "Check-List of North American Birds," together with the exhaustive collections of the American Museum of Natural History, have given me an opportunity to test this tradition statistically for one continent throughout the entire order of Passeres. The results are listed in Tables I and II. Among 27 subspecies of insular larks, jays, wrens, kinglets, shrikes, vireos and finches, covering a zonal range between the Arctic and the Tropics along both coasts of North America, 78 per cent. prove to have larger bills than their mainland representatives. When subspecies have developed into species—if that be, in truth, the actual procedure of evolution—this strange distinction becomes even more marked and we find that *every* North American insular species has a larger bill than its nearest continental kin. For the present, such a problem bids fair to stump geneticists and "environmentalists" alike!

TABLE I

Twenty-one subspecies of North American passerine birds breeding exclusively on islands, as listed in the A. O. U. Check-List, 1931, which have relatively larger bills than their nearest mainland representative races:

Subspecies	*Breeding Range*
Nannus hiemalis meligerus	Aleutian Is.
“ “ *kiskensis*	“ “
“ “ *alascensis*	Pribilof Is.
“ “ *tanagensis*	Aleutian Is.
“ “ *petrophilus*	“ “
“ “ *semidiensis*	Semidi Is.
“ “ *helleri*	Kodiak I.
Thryomanes bewicki nesophilus	Santa Cruz and Santa Rosa Is.
Thryomanes bewicki catalinae	Santa Catalina Is.
Thryomanes bewicki leucophrys	San Clemente I.
Salpinctes obsoletus guadeloupensis	Guadalupe I.
Corthylio calendula obscurus	“ “
Vireo griseus maynardi	Florida Keys
Carpodacus mexicanus clementis	Is. off California and L. C.
Pinicola enucleator carlottae	Queen Charlotte Is.
Pipilo maculatus clementae	San Clemente and Santa Catalina Is.
Passerculus sandwichensis sandwichensis	Aleutian Is.
Aimophila ruficeps obscura	Is. off California
Passerella iliaca insularis	Kodiak I.
Melospiza melodia graminea	Santa Barbara I.
“ “ *clementae*	Is. off California

The remaining six island races in the same list, which do not have relatively larger bills than their closest mainland representatives:

Subspecies	*Breeding Range*
Otocoris alpestris insularis	Santa Barbara I.
Cyanocitta stelleri carlottae	Queen Charlotte Is.
Lanius ludovicianus anthonyi	Santa Barbara I.
Vireo griseus bermudianus	Bermuda
Melospiza melodia micronyx	San Miguel I.
“ “ *coronatorum*	Los Coronados Is.

77.8 per cent. of all the North American insular races are large-billed.

TABLE II

The 9 species of North American passerine birds breeding exclusively on islands, and properly comparable with continental forms, which have relatively larger bills than their nearest mainland representative species:

Species	*Breeding Range*
Progne cryptoleuca	Cuba
Aphelocoma insularis	Santa Cruz I.
Thryomanes brevicauda	Guadalupe I.
Compsothlypis graysoni	Socorro I.
Carpodacus mcgregori	San Benito I.
Carpodacus amplus	Guadalupe I.
Pipilo consobrinus	Guadalupe I.
Passerculus princeps	Sable I.
Junco insularis	Guadalupe I.

No exceptions: 100 per cent. of the island species have larger bills than their closest mainland relatives.

IV

Well, even if you freely admit the fascination and importance of problems in island ornithology, you may still reply, "Why the hurry? The world is overflowing with material for evolutionary research, and our grandchildren can take up these far-away matters after we ourselves have solved a greater proportion of the unknown that still lies within arm's reach."

But that hope is exactly what will not be capable of realization. The oceanic island work, at least, must be done soon or never. Islands comprise the most delicate and evanescent of environments for their native biotic communities as soon as civilized man and his satellites put in an appearance and proceed to upset the ancient balance. The list of organisms that have become extinct within the historic period fairly bulges with the names of astonishing island birds, from the dodo of Mauritius to the mamo of Hawaii. All the peculiar land birds of Tristan da Cunha Island, in the South Atlantic, have become extirpated since the introduction of hogs and rats. The remnant of the fauna of Tahiti is waging a rapidly losing struggle against domestic mammals, alien hawks, mynahs and weavers that have become established there, and against the wild-fire spread of lantana and other weeds that have already dispossessed much of the original vegetation. The same story is being repeated elsewhere; primitive conditions that may have flourished for a million years melt away when men of the dominant races, whether white or yellow, arrive to break the spell.

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[8] Cf. Dobzhansky, *op. cit.*, p. 165.

[9] Sewall Wright, 1932. *Proc. 6th Internat. Congr. Genetics*, Vol. 1, pp. 356–366.

Experimentalists are understandably impatient of data beyond reach of their breeding tests. But we should remember that the present age of experiment will some day be combined with an age of fuller correlation, when the inconceivably rich mine of factual matter now buried in the text of ten thousand outdated books will be drawn upon, and when zoological collections, no less than zoological literature, will be combed for now ignored truths that can then be properly fitted into the picture of life as a whole. We museum men collect and preserve not only with respect to our individual scientific predilections; rather, we may be said to share some of the characteristics of devoted librarians. We feel a heavy responsibility to lay up, while opportunity offers, a capital sum of the irreplaceable data of science, even though part of this fortune may not begin to bear interest at its proper rate for a long while to come.[10]

SCIENTIFIC EVENTS

RESEARCH GRANTS OF THE VIRGINIA ACADEMY OF SCIENCE

The Research Committee of the Virginia Academy of Science met on November 5 to make the regular awards for the encouragement of scientific research in Virginia. It had available for distribution $450, which included the $100 from the American Association for the Advancement of Science. It had in hand sixteen applications for grants amounting to $1,200. After long and careful consideration of each request the following awards were finally made:

To Professor James I. Clower, of the Virginia Polytechnic Institute, $50 provided the Virginia Polytechnic Institute would supply an equal amount for the purchase of a Robinson colorimeter for use in his study of lubricating oils in automobiles.

To Dr. J. Frank Hall and Dr. R. L. Simpson, of the Medical College of Virginia, $50 to be used in the purchase of animals and other supplies in their study of the changes in the abutment teeth and their surrounding tissues brought about by the additional stress applied through crown and bridge restorations.

To Dr. C. W. Lampson and Dr. A. I. Whitenfish, of the University of Richmond, $60 provided the University of Richmond would supply a similar amount needed for the purchase of a special condenser needed in their study of the dielectric constant as a factor in the "salting out" of non-electrolytes.

To Dr. M. J. Murray and Dr. F. F. Cleveland, of Lynchburg College, $97.50 to be used for the purchase of apparatus and supplies needed in their study of the Raman effect and molecular structure.

To Dr. A. A. Pegau, of the University of Virginia, $50 to help to defray the expenses in mapping an unmapped portion of the Petersburg granite, chiefly in Dinwiddie County.

To L. B. Snoddy, of the University of Virginia, $90 to help to defray expenses in the study of the luminous discharge in the aurora borealis as a function of time.

To M. A. Stirewalt and F. F. Ferguson, of the University of Virginia, $50 to help to defray their expenses in a study of the occurrence, distribution, taxonomy and physiology of the Turbellaria of the eastern United States.

Dr. J. Shelton Horsley, Sr., reported that the amount of the research fund had now been brought up to $13,000, and consequently the amount available for distribution next year should be correspondingly larger.

E. C. L. Miller,
Secretary

CONGRESS OF AMERICAN INDUSTRY OF THE NATIONAL ASSOCIATION OF MANUFACTURERS

A three-day Congress of American Industry opened in New York City on December 7. At this meeting the report was presented of the joint committee of leading industrialists and scientific men that was established last year to study *increasing production and employment through wider use of scientific research in industry*. A considerable part of the session held on December 8 was devoted to it. The chairman of the committee is M. H. Eisenhart, president of the Bausch and Lomb Optical Company, Rochester, N. Y.

The activities to be undertaken by the committee with relation to industrial research include:

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[10] The author wishes to express his appreciation of the privilege of discussing the genetic aspects of this paper with Dr. G. K. Noble and with Professors T. H. Morgan and Richard Goldschmidt.

Encouragement of wider use of scientifically trained men in industry.

A survey to determine advantages to smaller industries of maintaining research laboratories.

Promotion of cooperative research activities generally.

Study of advantages of cooperative technical research by industrial groups.

Encouragement of educational institutions to train men who can organize and carry on industrial research programs, especially in small factories.

In the field of "pure research"—research which does not necessarily have a commercial aim—the Joint Committee plans:

To study the importance of pure research to the public generally, and the problem of its adequate financing.

To analyze and express, in the business man's language, the objectives and industrial possibilities inherent in the long-term trends of present-day pure research.

To promote the employment of scientists in industry for the purpose of interpreting the trends and results of pure research and visualizing possibilities of applications to specific industries.

The speakers at a session on "Research, an Increased Asset for National Progress," were: Dr. Willard H. Dow, president of the Dow Chemical Company, Midland, Mich., representing management; Dr. Carl Breer, of the Chrysler Corporation, New York, representing industrial laboratories, and Dr. Isaiah Bowman, president of the Johns Hopkins University, representing independent laboratories.

Members of the Joint Committee include the following scientific men: Dr. Karl T. Compton, president of the Massachusetts Institute of Technology; Dr. George B. Pegram, dean of the Graduate School, Columbia University; Dr. R. A. Millikan, chairman of the Executive Council of the California Institute of Technology; Dr. Ross G. Harrison, chairman of the National Research Council; Dr. F. R. Moulton, permanent secretary of the American Association for the Advancement of Science; Dr. E. R. Weidlein, director of the Mellon Institute; Dr. Henry A. Barton, director of the American Institute of Physics, and Julius Weinberger, of the Radio Corporation of America.

Industrialists who are members of the committee are: W. B. Bell, president of the American Cyanamid Company, New York; J. C. Hilton, vice-president, Standard Oil Company of New Jersey, New York; J. F. Lincoln, president of the Lincoln Electric Company, Cleveland, Ohio; John F. Tinsley, president, Crompton and Knowles Loom Works, Worcester, and Philip C. Wentworth, treasurer, National Ring Traveler Company, Providence.

AWARD OF THE ROEBLING MEDAL OF THE MINERALOGICAL SOCIETY OF AMERICA TO DR. SCHALLER

AT its annual luncheon, to be held on December 28 in the Waldorf-Astoria Hotel in New York City in connection with the annual meeting of the Mineralogical Society of America, from December 28 to 30, the society will present the Roebling Medal to Dr. Waldemar Theodore Schaller, of the U. S. Geological Survey. Professor Esper S. Larsen, professor of petrography at Harvard University and former associate of Dr. Schaller on the U. S. Geological Survey, will make the presentation. The Roebling Medal was authorized by the Mineralogical Society in 1936. The medal is awarded for "Meritorious Achievement in Mineralogy and Allied Sciences." It has been named in honor of the late Colonel Washington A. Roebling, or Trenton, N. J. Colonel Roebling was by profession an engineer and, in connection with his father, John A. Roebling, constructed many famous bridges throughout the country. However, his chief interest, outside of his profession, was mineralogy and he maintained an intense delight in it throughout his life. He built up one of the most complete private collections in the United States and was so well acquainted with his specimens that although he collected some 16,000 different mineral specimens he was able to identify and describe them on occasion. His interest was not limited to the mere collection of rare specimens, but included the recent literature regarding them, and he often furnished specimens for research and analysis. His collection now forms part of the famous mineral display at the U. S. National Museum.

Dr. Waldemar Theodore Schaller, the second recipient of the Roebling Medal, was born in Oakland, Calif., and attended the University of California, from which he received a bachelor of science degree in 1903. Since that time he has been chemist and geologist with the U. S. Geological Survey, and this year will mark his thirty-fifth anniversary of service. In 1912, Dr. Schaller received his Ph.D. from the University of Munich. Dr. Schaller is a charter fellow of the Mineralogical Society of America, was its president in 1926 and since 1931 has been treasurer. He is a fellow of the Geological Society of America, the American Academy of Arts and Sciences, the Washington Academy of Sciences, honorary member of the New York Mineralogical Society, member of the American Chemical Society, American Institute of Mining and Metallurgical Engineers and of the British, French, German and Austrian mineralogical societies.

In his mineralogical work, Dr. Schaller has published about 150 papers and reports dealing with mineralogy and has described more than 40 new mineral species. Among these is the mineral, kernite, the most important borax mineral found in the United States. Much of his work has also been devoted to the mineralogy of the potash fields of New Mexico and Texas. Dr. Schaller is one of the leading authorities in the world on rare and unusual minerals. One of his most interesting contributions has been a study of the crystal cavities in the trap rock region of the Watchung Mountains of New Jersey. Dr. Schaller has also made a particular study of the interesting and beautiful minerals of pegmatites and their mode of origin.

PAUL F. KERR,
Secretary

MEDALS OF THE AMERICAN GEOGRAPHICAL SOCIETY FOR 1938

THE Charles P. Daly Gold Medal for 1938 of the American Geographical Society of New York has been awarded to Dr. Alexander Forbes, professor of physiology in the Harvard Medical School.

Early in 1931, largely at the suggestion of Sir Wilfred Grenfell, Dr. Forbes undertook a geographical survey in northern Labrador, and expeditions to that region were made under his leadership in 1931 and 1935 and under his direction in 1932. Dr. Forbes saw the possibilities in a new method of surveying from the air that was being developed by the American Geographical Society. Through his expeditions the opportunity was offered the society of thoroughly testing the method in the field and of demonstrating its practicability, and as a consequence, the northernmost end of the Labrador peninsula, previously almost wholly unknown, has been accurately mapped.

Louise A. Boyd, explorer and geographer, who returned on November 30 from her sixth expedition to the Arctic, has been awarded the Cullum Gold Medal for 1938 in recognition of her achievement in Arctic geographical research. She is the second woman to receive one of the awards of the society.

According to the official announcement made public by the society, Miss Boyd is the only woman to achieve an outstanding position in Arctic exploration. This past summer she penetrated the berg-infested waters off the coast of Greenland to a point further north than had been reached by ship by any other American, and to within thirty miles of the northernmost latitude (78 degrees 16 minutes N., 16 degrees 21 minutes W.) reached by the Duc d'Orléans in 1905. With her were a scientific staff consisting of a surveyor, a geologist, a hydrographer and a radio operator to carry on research on short wave transmission. This was her fourth expedition conducted under the auspices of the American Geographical Society.

Among other explorers who have received the Cullum medal in the past are: Peary, Nansen, Scott, the Duke of the Abruzzi, Shackleton, Prince Albert of Monaco and Bertram Thomas.

RECENT DEATHS AND MEMORIALS

DR. WILLIAM MCDOUGALL, since 1927 professor of psychology at Duke University and from 1920 to 1927 professor of psychology at Harvard University, previously reader in mental philosophy at the University of Oxford and a fellow of Corpus Christi College, died on November 28 at the age of sixty-seven years.

DR. ALCAN HIRSCH, president of the Hirsch Laboratories, New York, and consulting chemical engineer, died on November 24 at the age of fifty-three years.

DR. DAVID ROBERT COKER, a plant breeder and cotton expert, died on November 28 at the age of sixty-eight years. Dr. Coker was the originator of staple cotton varieties. He was a trustee of the University of South Carolina.

M. GEORGES URBAIN, French chemist, died on November 5 at the age of sixty-six years. He was a professor at the Institute of Biology in Paris and for several years professor of theoretical chemistry and chairman of the section of chemistry of the School of Advanced Study at the University of Paris.

Nature reports the death of Dr. P. A. Murphy, professor of plant pathology in the Albert Agricultural College, University College, Dublin, on September 27, aged fifty-one years, and of Paul Helbronner, the geodesist, "free member" of the Paris Academy of Sciences, on October 18, aged sixty-seven years.

THE fortieth anniversary of the discovery of radium and the seventy-first anniversary of the birth of Madame Curie were commemorated on November 6 in New York by Polish-Americans and representatives of Poland and France, under the auspices of the New York State Conference of Polish Clubs and the United St. Stanislaus Societies. Dr. Francis Carter Wood, director of the Crocker Cancer Research Institute of Columbia University, made the principal address.

THE British Society of Chemical Industry celebrated on November 24 the centenary of Sir William Perkin, the discoverer in 1856 of the first aniline dyestuff, mauve.

SCIENTIFIC NOTES AND NEWS

A DINNER in celebration of the fiftieth anniversary of the founding of the department of biology at Western Reserve University and the fifty years of service there of Dr. Francis H. Herrick, now professor emeritus of biology, was held on December 3. President Winfred G. Leutner served as toastmaster. Dr. E. G. Conklin, executive vice-president of the American Philosophical Society and professor emeritus of biology at Princeton University, gave the principal address.

The seventieth birthday of Dr. Thomas S. Cullen, retiring professor of gynecology of the Medical School of the Johns Hopkins University, was celebrated at a dinner given in Baltimore on November 19. Harry Nice, formerly governor of Maryland; Phillips Lee Goldsborough and Mayor Jackson were among the speakers. Other speakers were: Dr. Howard A. Kelly; Dr. J. M. T. Finney; Dr. Abraham Flexner, director of the Institute for Advanced Study at Princeton; and Dr. Isaiah Bowman, president of the Johns Hopkins University. A portrait of Dr. Cullen, by the late Thomas Corner, was presented by Mrs. Cullen. It was accepted by Dr. Bowman and will be hung in the women's clinic.

Dr. E. V. McCollum, professor of biochemistry and head of the department of biochemistry of the school of hygiene and public health of the Johns Hopkins University, was the guest of honor at an anniversary dinner of the National Dairy Council held in Chicago on November 30. Dr. McCollum, who was introduced by Dr. Morris Fishbein, editor of the *Journal* of the American Medical Association, gave an address on his work on nutrition.

The Chemists' Club, New York, gave on December 2 a testimonial dinner in honor of Dr. Leo Hendrik Baekeland, honorary professor of chemical engineering at Columbia University and president of the Bakelite Corporation. At this dinner honorary membership in The Chemists' Club was conferred upon him. Dr. Baekeland is known for his invention of Velox photography and the discovery of Bakelite resinoid.

Dr. F. R. Moulton, permanent secretary of the American Association for the Advancement of Science, was the guest of honor at a dinner given at Richmond on November 25 by the Virginia Section of the American Chemical Society. After the dinner Dr. Moulton delivered an address entitled "Celestial Chemistry and Engineering."

Sir Richard Gregory arrived in New York on December 1. He will deliver on December 9 the Elihu Root lecture of the Carnegie Institution on "Cultural Contacts of Science." He will give an address before a general session of the American Association for the Advancement of Science at Richmond on December 29, and will be the principal speaker at a dinner of the National Association of Science Writers on December 26. Before sailing for the United States a dinner was given in honor of Sir Richard at the Athenaeum Club, London, to mark his retirement as the editor of *Nature*.

Dr. Henry C. Christensen, of Chicago, secretary of the National Association of Boards of Pharmacy, received the Remington Medal of the New York Branch of the American Pharmaceutical Association at a dinner given in his honor on November 30 at the Hotel Pennsylvania. The award was presented by Dr. Henry V. Arny, dean emeritus of the School of Pharmacy of Columbia University. The speakers were: Robert Swain, deputy commissioner of health for Maryland; E. F. Kelly, secretary of the American Pharmaceutical Association, and J. Leon Lascoff, president of the association.

Miss Alice Eastwood, for the past forty-six years curator of botany in the California Academy of Sciences, turned the first shovelful of earth in the ground-breaking exercises for the Floricultural Building at the Golden Gate International Exposition on November 26. John McLaren, superintendent of Golden Gate Park since 1887, and Miss Kate O. Sessions, horticulturalist of San Diego, were also honored in the ground-breaking exercises, over which Professor Sydney B. Mitchell, of the University of California, presided.

The Albers-Schönberg Medal of the German Röntgen Society has been conferred on Dr. Hans Holfelder, professor of general clinical roentgenology at Frankfort-on-Main.

Dr. Malcolm Goodridge, formerly professor of clinical medicine at Cornell University Medical College, was elected president of the New York Academy of Medicine for a two-year term at the annual meeting held on December 1. He succeeds Dr. James Alexander Miller. Dr. Rufus Cole, who retired last year as director of the Hospital of the Rockefeller Institute for Medical Research, was elected vice-president for a three-year term. Dr. Bernard Sachs, neurologist and a former president of the academy, was chosen treasurer for three years; Dr. Miller and Dr. Charles F. Tenney were elected trustees for five years; Dr. Carl G. Burdick was elected a trustee to fill the unexpired term of the late Dr. Frederick Tilney.

Assistant Professor Augustus Sisk, of the University of Tennessee, has been elected head of the department of mathematics and physics at Maryville College, Tennessee.

Dr. Benjamin Kropp has resigned as instructor in anatomy and research fellow in obstetrics at the Harvard Medical School, to become lecturer in embryology at Queen's University Medical School, Kingston, Ontario.

Dr. Herbert Shapiro, formerly of Princeton University, has been appointed research associate in general physiology at Clark University.

Officers of the Engineers' Council for Professional Development, of which the constituent societies are the American Society of Civil Engineers; the American

Institute of Mining and Metallurgical Engineers; the American Society of Mechanical Engineers; the American Institute of Electrical Engineers; the American Institute of Chemical Engineers; the Society for the Promotion of Engineering Education and the National Council of State Boards of Engineering Examiners, have been elected for the year 1938–1939 as follows: *Chairman,* J. P. H. Perry, vice-president of the Turner Construction Company, New York City; *Vice-chairman,* R. E. Doherty, president of the Carnegie Institute of Technology, Pittsburgh; *Secretary,* S. L. Tyler, secretary of the American Institute of Chemical Engineers, New York City; *Assistant secretary,* C. E. Davies, secretary of the American Society of Mechanical Engineers, New York City. The United Engineering Trustees, Incorporated, will continue to act as treasurer.

James G. Osborne has been appointed chief of the Section of Forest Measurements, U. S. Forest Service. He succeeds F. X. Schumacher, who resigned some time ago to accept a professorship in the Graduate School of Forestry at Duke University.

Stanford University School of Medicine announces the award of a grant by the Committee on Scientific Research of the American Medical Association to the department of surgery, to be used by Dr. Frederick A. Fender in the development of a device for direct electrical stimulation. The committee has extended to Dr. Irving J. Wolman, of the department of pediatrics of the University of Pennsylvania, a renewal of the grant for experimental studies on Lipoid Pneumonia.

Dr. Ruth M. Addoms, assistant professor of botany at Duke University, who has been granted sabbatical leave for the second semester of the current year, will spend several months at the University of Leeds, in the laboratory of Professor J. H. Priestley.

Dr. Eugene F. Du Bois, professor of medicine at Cornell University Medical College, will deliver the third Harvey Society Lecture of the current series at the New York Academy of Medicine on December 15. Dr. Du Bois will speak on "Heat Loss from the Human Body."

Dr. Henry G. Knight, chief of the Bureau of Chemistry and Soils of the U. S. Department of Agriculture, gave a lecture before the New York University Chapter of Sigma Xi on November 17. He spoke on "The Role of Minor Elements in Agriculture."

Dr. J. Shohat, professor of mathematics at the University of Pennsylvania, will give at the Graduate School in the U. S. Department of Agriculture, beginning late in January, a series of six lectures on interpolation and mechanical quadrature.

Dr. Raymond L. Ditmars, curator of reptiles of the New York Zoological Park, gave a lecture illustrated with moving pictures on November 28, the opening night of the annual arts and sciences week at the University of Missouri. The lecture was entitled "Our Animal Friends and Foes."

Sir William Bragg, president of the Royal Society, delivered an address on "The Advance of Science" at the Ely Diocesan Conference, which was held at Cambridge on November 21.

The fourteenth annual Norman Lockyer Lecture was given in London under the auspices of the British Association on December 6 by Dr. H. Spencer Jones, astronomer royal. The subject of the lecture was "The Atmospheres of the Planets."

The New York Academy of Sciences and affiliated societies will hold their annual dinner and meeting at the Hotel Astor, New York City, on the evening of December 14. There will be lectures by Dr. Victor K. LaMer, professor of chemistry at Columbia University, and by Dr. Roy Waldo Miner, curator of living invertebrates at the American Museum of Natural History.

A joint meeting of the Pasteur Society of Central California and the California Academy of Sciences commemorating the centenary of the cell theory was held on November 10 in San Francisco. Following a dinner at the Western Women's Club, addresses were given as follows: "The Development of the Cell Theory," by Dr. F. M. MacFarland, president of the academy; "The Influence of the Cell Theory," by Dr. Robert C. Miller, director of the academy's museum and Steinhart Aquarium; "The Chemical Architecture of the Cell," by Dr. Chauncey D. Leake, professor of pharmacology in the University of California Medical School. Dr. Charles Edward Smith, president of the Pasteur Society, presided.

The subsection on pharmacy of the Section on the Medical Sciences of the American Association for the Advancement of Science has organized a symposium on glycols for the meeting in Richmond. The program, which will be presented on Tuesday, December 27, is as follows: (1) The Chemistry of Glycols, Dr. Frank C. Whitmore, president of the American Chemical Society; (2) The Pharmacology of the Glycols, Dr. H. O. Calvery, chief of the Division of Pharmacology, Food and Drug Administration, U. S. Department of Agriculture; (3) The Industrial Applications of the Glycols, H. B. McClure, Carbide and Carbon Chemicals Corporation; (4) The Pharmaceutical Uses of the Glycols, Dr. A. G. Du Mez, dean of the School of Pharmacy, University of Maryland, editor of *Pharmaceutical Abstracts.* Discussion will be opened by Dr. H. B. Haag, professor of pharmacology of the Medical College of Virginia, and Dr. M. G. Mulinos, of the College of Physicians and Surgeons, Columbia University.

The National Council of Teachers of Mathematics will hold on December 29 and 30 its fifth annual meeting at Williamsburg, Va. The general subject of the meeting will be "Mathematics that Functions." There will be a joint dinner with the Mathematical Association of America and the American Mathematical Society on December 29. The council will meet in three sections as follows: Arithmetic Section, Secondary Mathematics Section and Teacher Training Section.

The Medical College of Virginia, Richmond, celebrated Founders' Day marking the one hundred first anniversary of its founding on Thursday, December 1. Virginius Dabney, editor of the *Richmond Times-Dispatch,* spoke on "Medicine in a Changing World." The exercises were preceded by an academic procession of visitors, faculty and members of the student body.

An aerial survey of an hour's duration of the geology of the New York region, sponsored by the Geological Society of America, is planned for Saturday morning, December 31, at the semi-centennial meeting of the society, which will be held in New York City from December 28 to 30. The trip will be led by Dr. Girard Wheeler. The group will start from the Newark airport and fly up the Hudson River past the Palisades, then northward to see the escarpment at the edge of the highlands. The plane will then swing southeast over Long Island Sound, where there have been changes resulting from the recent hurricane. After viewing the Long Island shoreline the return will be made to the Newark airport by way of Staten Island.

Western Reserve University has received as a legacy from the late Mary Frances Morris, who died on August 2, a business building at 500 Prospect Avenue, in Cleveland. The yearly income, amounting to $2,000, is to be used for scholarships for young women in Flora Stone Mather College.

The Meyerstein Institute of Radiotherapy at the Middlesex Hospital, for the treatment of cancer by radium and x-rays, was recently opened by Sir William Bragg, president of the Royal Society. Its erection was made possible by a gift of $230,000 from Sir Edward Meyerstein. All forms of radiotherapy are available both for the in-patients and out-patients of the hospital and for private patients.

As has already been reported in Science, David Cleghorn Thomson, formerly secretary to the Oxford University Appeal Committee, has been appointed general secretary, in succession to Mr. Walter Adams, of the Society for the Protection of Science and Learning (formerly known as the Academic Assistance Council) which for five years has been handling the academic side of the international refugee problem. *Nature* states that Cleghorn Thomson is a graduate of the Universities of Edinburgh and Oxford; a senior history exhibitioner of Balliol, he was for seven years the B.B.C.'s chief official in Scotland. The Society for the Protection of Science and Learning, of which the Archbishop of York recently became president in succession to the late Lord Rutherford, acts as a central bureau of information regarding professors, lecturers and research workers displaced in their own country on account of "race," religious or political opinions, and aids in securing the continuation of their valuable work in other countries. So far, of the 1,350 displaced scholars registered with this society, 520 have been permanently placed in thirty-eight countries, apart from more than 300 who have temporarily found work. Within the last three months, the society has received 340 applications from scholars who have had to discontinue academic activity in Austria. The offices of the society are at 6 Gordon Square, London, W.C.1.

The senate of the University of London invites applications for the university chair of medicine, tenable at University College Hospital Medical School, with a salary of £2,000 a year. Applications (twelve copies) must be received not later than January 16 by the Academic Registrar, University of London, Senate House, W.C.1, from whom further particulars can be obtained.

DISCUSSION

PHOTOSYNTHESIS AND THE LIVING STATE

It is hardly necessary to remark that no new definition of "The Living State" is contemplated. For the purposes of these remarks we may assume that the living state is associated with the heterogeneous but organized substance called protoplasm, and that such criteria as growth, reproduction, respiration and photosynthesis will be sufficient identification.

Hans Molisch[1] was perhaps the first investigator to announce that the evolution of oxygen from green plant cells was possible when the organism was no longer alive. He also attributed this important reaction to an enzyme. The data which led him to these conclusions were the fact that he could dry leaves for a few days at temperatures not above 30 degrees Centigrade and they would still evolve oxygen when moistened and illuminated.

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[1] H. Molisch, *Zeits. Bot.*, 17: 577, 1925.

In repeating Molisch's work it was found that the results could be confirmed readily with some plants but not with others. It was also found that if the plant leaves were ground with the proper buffers and then dried there was loss of the power to evolve oxygen. Luminous bacteria were used by both Molisch and the author to test for the release of free oxygen.

In undertaking further experiments along this line several methods of inhibiting the evolution of oxygen by irradiated organisms containing chlorophyll have been tried.

Nitella sp. cells were cut and the contents squeezed out and immediately tested for the evolution of oxygen. The results indicate that a positive test can be found if there is only a few minutes' delay between the time the cell contents are extruded and the test for the evolution of oxygen. The cell contents of *Valonia macrophysa*,[2] mixed with luminous bacteria, remained capable of evolving oxygen for two hours after cell disorganization. These cells were about one centimeter in diameter and even the evolution of oxygen from a single cell could be easily detected.

Press juice obtained by placing lawn clover (*Trifolium repens*) under high pressure evolved oxygen readily. Microscopic examination showed that no cells were present.

The reactions of *Euglena viridis* to low temperatures were the basis for the most of the present work. The *Euglena* cultures were grown in diffuse or artificial light at room temperatures.

When *Euglena* is kept at - 4 degrees Centigrade for four hours and then brought back to room temperature (about 20 degrees Centigrade) the microscopic appearance indicates some plasmolysis and a tendency for the cells to become spherical. The evolution of oxygen is very weak and sometimes negative, apparently depending on the state of the culture used. At - 40 degrees Centigrade for 20 minutes, with about one hour at room temperature to recover, there is generally evolution of oxygen when tests are made immediately. In fact, some cultures were frozen eight hours at - 40 degrees Centigrade and tests for the evolution of oxygen made at once were positive. In all cases where freezing was at - 40 degrees Centigrade for six hours the evolution of oxygen was only a temporary matter and the cultures would no longer grow in nutrient media. Tests for the absorption of carbon dioxide in a closed tube using phenolsulfonephthalein as an indicator were negative after four hours' freezing at - 4 degrees Centigrade or one hour at - 40 degrees Centigrade. Many experiments demonstrated that when both the absorption of carbon dioxide and the evolution of oxygen were negative the cultures would no longer grow. In many cases there was evidence that no carbon dioxide absorption was taking place in light, even though there was a temporary evolution of oxygen by the culture.

Euglena, *Spirogyra* and moss leaves showed much variability to freezing, and subsequent tests for the evolution of oxygen seemed to show that in some organisms there was a storage of some substance which would evolve oxygen for a short period of time, even though cells were absent or were so injured that they did not recover. One is reminded of the storage of luciferin-luciferase by *Cypridina* so that the protein enzyme complex can be extracted and perform its reaction of evolving light *in vitro*, but the inability to do the same with luminous bacteria. The explanation usually given for this observation is that the luminous bacteria do not store the luciferin-luciferase system, while *Cypridina* does.

These experiments tend to support the assumption that the evolution of oxygen is an enzyme reaction depending on radiation and not necessarily on the living cell except for the formation of the substance. This is further confirmed by the fact that hundreds of tests made on cell contents have shown that once the power to evolve oxygen is depleted in cell-free material, there is never any recovery. This would probably mean that there is a good chance that the complex responsible for the evolution of oxygen upon irradiation may be isolated, but it does not help much in looking forward to the understanding of how the living cell builds the oxygen-evolving substance.

It seems clear that we may conclude that the cells of some green plants may be disorganized and killed and yet retain for a short time some of their power to evolve oxygen upon irradiation. It is, however, very doubtful whether the absorption of carbon dioxide takes place so that a regular photosynthetic cycle is set up in such triturates. This points to the fact that there is, after all, a close relationship existing between the whole mechanism of photosynthesis and the organized living green plant cell.

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[2] These *Valonia* cells were supplied by Dr. W. J. V. Osterhout, of the Rockefeller Institute, New York City.

A SULFOXIDE OF METHIONINE

Owing to the biological interest attached to the sulfur-containing amino acid methionine any of its oxidation products are of potential significance. When a solution of dl-methionine perchlorate in isopropyl alcohol is allowed to react with an excess of hydrogen peroxide the amount of oxygen consumed upon completion of the reaction corresponds to one atom per molecule of methionine. Neutralization of the perchloric acid with amylamine causes a precipitate that consists, according to analysis and properties, of practically pure methionine sulfoxide in a yield of over 90 per cent. The amorphous precipitate can be converted into the form of microcrystalline aggregates by careful precipitation by acetone from aqueous or aqueous-methanolic solution. The product decomposes at 220–230° and appears to be more soluble than any of the natural amino acids: 1 gram dissolves in about 1.5 cc of water, while about 30 cc are required by the parent substance dl-methionine. The solubility in methanol seems similarly increased. The acidity of an aqueous solution is that of a typical neutral amino acid (pH about 4.5). The compound does not oxidize iodide under the conditions which cause complete deoxygenation of cystine disulfoxide,[1] but concentrated (57 per cent.) hydriodic acid liberates almost instantaneously the expected amount of iodine.

This product, which has not been isolated previously, although it has been discussed,[2] is of interest (a) chemically, because it should consist of a mixture of equal parts of four stereoisomeric structures as the molecule contains, in addition to the "asymmetric" carbon atom, an "asymmetric" sulfur atom; (b) technically, on account of its high solubility which might be utilized in the isolation of the natural l-methionine; and (c) biologically, in connection with Hammett's[3] theory[4] on the role of intermediate oxides of sulfur in the control of cell division. Separation of the four isomers seems desirable and should also be of interest in relation with the problems of the metabolic decomposition of methionine.

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[1] *Jour. Biol. Chem.*, 113: 583, 1936.

[2] *Biochem. Jour.*, 22: 1417, 1928, and 26: 2041, 1932.

[3] *Protoplasma*, 11: 382, 1930.

[4] In its application to neoplasia a new confirmation of this theory, by sulfur oxides of the sulfanilamide type (*Biochem. Jour.*, 32, 1207, 1938, has just been added to an earlier confirmation by cystine disulfoxide (*Am. Jour. Cancer*, 26: 554, 1936).

COMMENTS ON THE SHAPE, GROWTH AND QUALITY OF THE AMERICAN OYSTER

Lunz[1] gave data showing that oyster shells from Indian shell heaps are larger than present-day oysters from South Carolina commercial beds and stated that small size of the latter is probably due to intensive commercial oystering, which prevents maximum growth. He stated that the evident quality of pre-colonial oysters far surpassed those of to-day. The situation is more complex than the short treatment indicated.

Unfortunately, there was a misstatement about the percentages by which the pre-colonial oysters exceeded present oysters in size. Ordinary pre-colonial oysters were said to be 62.23 per cent. longer and 76.89 per cent. wider than modern oysters. The correct figures are 60.67 and 42.61, respectively, according to the data.

Oysters take various shapes imposed on them by contact with their fellows or other solid materials, but there are two general shapes. On hard bottom with sufficient room oysters grow almost as wide as long and in rare instances wider. The long axis of growth curves to the right. Illustrative of this type are wild oysters of Karankawa Bay, Texas, mentioned by Galtsoff.[2] Round oysters have heavy shells with both valves cupped. They have a large adductor muscle, are usually fat, have a high gallon yield per barrel of shell stock and shrink little due to loss of fluid after being opened, so that they are always in demand by the trade.

Where oysters are crowded or growing on soft bottom and slowly sinking the shell grows straight, upright and very long. The shell is thin, much longer than wide, the bottom (left) valve alone is troughed, the adductor muscle grows rapidly forward and smaller in proportion to the size of the animal than in round oysters. These oysters are known as snappers or coons. Galtsoff and Luce[3] discussed conditions which produce them and stated that in "old times" coon oysters existed in Long Island Sound and Connecticut, with the unstated inference that these have given way to the rounder cultivated type.

Coon oysters from Coon Island, Matagorda Bay, culled for market size by an oysterman, were selected for straightness and the top valve length and width measured with a vernier caliper. The small culls were also measured. Oysters from Wells Point, Matagorda Bay, selected for market size and roundness, were measured. Measurements of unattached seed oysters from the same locality, unselected, although they were of the round type, were on hand. These data were compared with those of Lunz (changed to centimeters for comparison) in the table. Measurements of the lower valve from hinge to bill, as made by Lunz, are slightly shorter than the upper valve.

Examination of the length/width ratios show that selected oysters from Indian shell heaps were "coons," as were selected oysters from South Carolina commercial beds. Likewise, average oysters from shell piles were nearer the coon type than average oysters from

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[1] G. Robert Lunz, Jr., Science, 87: 367, 1938.

[2] P. S. Galtsoff, Bur. Fish. Invest. Rep. No. 6, 1–30, 1931.

[3] P. S. Galtsoff and E. H. Luce, Bur. Fish. Doc. 1077: 61–100, 1930.

TABLE I

Measurements in Centimeters and Length/Width Ratios of Oysters from Matagorda Bay, Texas, Compared With Data of Lunz[1]

Type of oyster	Number	Average length	Average width	L/W ratio
Small round	200	3.57	3.08	1.16
Market size round.....	112	9.48	7.58	1.25
Small coons	139	7.63	3.81	2.00
Market coons	153	11.74	5.07	2.32
South Carolina Oysters				
Selected shells, Indian shell heaps	10	16.61	6.50	2.56
Selected oysters, S. C. commercial beds..	140	9.93	4.90	2.03
Ordinary shells, Indian shell heaps	50	10.90	6.38	1.71
Ordinary oysters, S. C. commercial beds..	150	6.78	4.47	1.52

commercial beds. Oysters in the latter category averaged only 2.67 inches in length. The quality must have been poor, for minimum legal market size in most Southern states is 3 or 3½ inches.

Both sets of data show that the length/width ratio increases with size for both round and long oysters, but the increase is greater for the elongate type.

Coon oysters often grow in shallow water and are taken by hand so much that wading for oysters is known in some localities as cooning. This oyster was more easily obtained by the American Indian than the round oyster from deeper water. It seems plausible that small populations of Indians had the choice of larger oysters than those coming from intensively fished wild reefs of certain localities to-day. However, well-cultivated beds and some wild beds produce oysters comparable in size, although shorter in length, to any the Indian was able to obtain.

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THE FERMENTATION TEST FOR VITAMIN B_1

In October of 1937 there appeared in Science a short note by R. J. Williams[1] on the use of yeast or other fungi for vitamin B_1 tests. In it Dr. Williams coupled our fermentation test[2, 3, 4] with Schopfer's growth test. Reference to the original note on our fermentation test[3] will show that the test is in no way related to growth and, in fact, test conditions tend to exclude growth of the yeast.

No attempt was made, at the time, to correct the impression created by Williams's note because it was thought that the reader would readily detect the error. However, in a recent book on vitamin B_1 by R. R. Williams and Spies[5] these authors have repeated the remarks referred to above.

It is to be hoped that by calling attention to the above inaccuracies in the literature, a more correct appraisal of the fermentation test will be made possible. This useful and rapid method for the determination of vitamin B_1 has been successfully employed in our laboratories for several years.

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Lawrence Atkin
Charles N. Frey

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APPEAL FOR AID FROM CZECHO-SLOVAKIA

In a letter of October 31 from Professor K. Absolon, curator of the Moravian Museum, Brno, Czecho-Slovakia, the writer appeals for aid with subscribers to the monthly *Příroda* (Nature), which as a result of the recent crisis has lost many local subscriptions and is thereby endangered in its existence. Professor Absolon asks that this matter be brought to the attention of the American libraries and establishments, as well as workers in natural history. The periodical in question has now reached thirty-one volumes. Its contents resemble those of *Popular Science Monthly*, with many original scientific reports and observations. All the original contributions, especially for the future, are and will continue to be provided with translations of their titles and text of illustrations, as well as with an adequate summary in English, French, German or Italian. The yearly subscription price of the periodical for America is $3.00.

A. Hrdlička

U. S. National Museum

SCIENTIFIC BOOKS

ANIMAL PARASITOLOGY

Traité de zoologie et de parasitologie médicale et vétérinaire. By M. Neveu-Lemaire, professeur agrégé des facultés de médecine, Paris. Published by Vigot Frères, éditeurs.

It is just fifty years since the appearance of the great treatises of Blanchard on human parasites and of Neumann and Railliet on those of domestic animals which gave to scientific students reference works of comprehensive character for the rapidly expanding field of animal parasitology. In this half century the knowledge of the structure and activities of these organisms and an understanding of their significance in human welfare have been largely increased by active students of the field. Many general publications covering various aspects of the subject have been contributed by workers in all countries, but it has been left for Neveu-Lemaire to solve the difficult problem of bringing together all the work accomplished and of including it without serious loss in a single treatise, which should give a successful picture of the entire field.

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[1] R. J. Williams, Science, 86: 349, 1937.

[2] A. S. Schultz, L. Atkin and C. N. Frey, *Jour. Amer. Chem. Soc.*, 59: 948, 1937.

[3] *Ibid.*, 59: 2457, 1937.

[4] *Ibid.*, 60: 1514, 1938.

[5] R. R. Williams and T. D. Spies, "Vitamin B_1 and Its Use in Medicine," Macmillan, 1938.

Of this monographic undertaking, which is to comprise three volumes—helminthology, entomology and protozoology—the first and second have already appeared and the third is approaching completion. The volume on helminthology contained 1,544 pages and was illustrated by 787 figures. The volume on entomology, which has just come from the press, has 1,376 pages and 597 figures. Both volumes are worked out on the same plan. The first section is devoted to a consideration of general topics in that field, starting with a historical sketch and including thereafter discussions of degree of parasitism, origin of the parasitic habit, details of life history and mode of attack as evolved by various types of parasites, responses of the host to parasitic invasion and other biological problems involved in the varying interrelations of the organisms.

The second section treats of the anatomical and taxonomic features of the various genera and species of the parasites of man and the domestic animals. The geographic distribution of these forms has been well worked out and emphasis laid on their pathogenic rôle in parasitic diseases which has been shown to be highly significant through the investigations especially of the last forty years. This section is well organized, complete and up-to-date, and naturally it occupies the major part of each volume. An extended discussion of hosts and the different taxonomic groups of free living animals which give shelter and sustenance to particular parasites brings together in lists, tables and condensed forms a mass of valuable material not otherwise easily available to students in parasitology.

The illustrations are reasonably numerous, in large part new, and so far as checked also rightly credited to their original sources. The volumes are well printed and provided with good indexes. As the result of detailed checking of the data given in various sections of these volumes, the reviewer has been impressed with the breadth and accuracy shown. This work justly ranks as the most comprehensive treatise of recent date in this field. Work done in all European and extra-European laboratories has been carefully brought together and due credit given to foreign authors, thus escaping the criticism of national overemphasis charged against some writers. The text manifests that clarity and effectiveness in style generally characteristic of French publications. The treatise is a most valuable addition to the literature of parasitology.

HENRY B. WARD

SOLAR RADIATION

Etude Practique des Rayonnements Solaire, Atmospherique et Terrestre (*Methodes et Resultats*). By CH. MAURAIN. Paris, 1937.

THIS is a very comprehensive summary of our present knowledge on the important subject of the character, the intensity and the duration of solar radiation. It covers 188 octavo pages, is divided into 14 chapters, contains 38 tables of data and is illustrated by 18 text figures.

The author points out the close relation between the intensity of solar radiation and related problems of interest to mankind, such as climatology, the thermodynamics of the atmosphere and forecasting the weather.

He also refers to the difficulties encountered in attempting to obtain measurements of the degree of accuracy necessary to obtain comparisons between the intensities of similar elements at different points on the surface of the earth, as is done in forecasting the weather. For example, in order to exclude all sky radiation from measurements of the intensity of direct solar radiation, it has been found necessary to cover the outer end of the long tube, or vestibule, of the pyrheliometer with a thin glass cover, which must be kept free from dust. A long vestibule requires a driving clock of considerable power and accuracy. It has been found that at Blue Hill, the ratio between the readings of the Smithsonian silver disk pyrheliometer and the Eppley pyrheliometer, which records automatically on a Wheatstone bridge, does not vary from 0.400 by more than ± 0.001, provided all adjustments are accurately made and maintained.

In Chapter V, Table V, are summarized monthly means of atmospheric transmission for stations varying in latitude from 2° south to 51° north, and from altitude 8 m to 3,492 m above sea level, for each season of the year. The greatest monthly variation is shown at Turin, 66 per cent. in September to 79 per cent. in February and April. The least variation is shown at Calama, Chile, from 79 per cent. in January to 84 per cent. in August and September. The latter location was selected by the Smithsonian Institution for one of its stations for determining the value of the solar constant of radiation, on account of the small amount of variation from month to month in the atmospheric coefficient of transmission.

Linke adopted the factor

$$T = \frac{\text{Total atmospheric depletion}}{\text{Depletion by pure dry air}}.$$

This factor becomes large in industrial cities, as is shown in the more equable climate of urban than of suburban regions.

Chapter VI treats of the total radiation received on a horizontal surface, directly from the sun and diffusely from the sky, and also from cloud sheets, either transmitted or reflected. This is an important subject, and Ångstrom's treatment of it is given in detail.

In this chapter, "Global radiation" is defined as the total radiation received from the sun, either directly, or diffusely from the sky; and in Fig. 11 are shown typical records, obtained on a day with sunshine, and also on cloudy days.

In chapter VII the radiation from the earth to the sky is considered, which is easily measured during the night hours, but which is taking place at all hours of both day and night, although under certain conditions of cloudiness its intensity becomes very low, or even negative in direction, when a cold surface is covered by warm clouds.

The seven chapters reviewed treat of the subject under consideration from the statistical standpoint. The remaining chapters consider it from the theoretical standpoint, which is quite apart from the treatment here reviewed.

HERBERT H. KIMBALL

VITAMIN B_1 AND ITS USE IN MEDICINE

Vitamin B_1 and Its Use in Medicine. By ROBERT R. WILLIAMS and TOM DOUGLAS SPIES. The Macmillan Company Monographs. The Macmillan Company, 1938.

DEFICIENCY of vitamin B_1 (thiamin) is the cause of beriberi, which, since the dawn of medical history, has been one of the major health problems, as it is to-day, in populations subsisting largely upon polished rice. There is increasing evidence that deficiency of this nutrient occurs in the United States to a degree which impairs the health of a considerable number of people. It is, therefore, one of the most interesting of the food factors which are essential in the diet. Since its existence was first demonstrated by Eijkman, in 1897, thiamin has been investigated by many investigators. The greatest achievement in this field of research was the improvement of the yield of the vitamin by Dr. Williams from rice polishings, so that about an ounce of crystalline material was made available for chemical study. With this material, Dr. Williams and his associates succeeded in determining the structure of the molecule and in following up this knowledge in an astonishingly short time by its synthesis. The synthetic vitamin has now become available at moderate cost in any quantities which may be necessary for the prevention of beriberi and for clinical use.

In Part I of the book, "Vitamin B_1 and Its Use in Medicine," the authors have discussed in a concise way all aspects of thiamin deficiency which may be instructive to medically trained readers, and suggest the clinical conditions in which thiamin deficiency may be suspected. Every clinician should be familiar with the recorded experience with thiamin in therapy, and many will gain by reading this excellent discussion suggestions which they will want to apply in their practice.

Part II is devoted to the fascinating story of the researches which have yielded our present knowledge of the vitamin, its physiological role and its final synthesis.

This book should be read by every biochemist, physiologist and progressive physician. The reader may be assured that he will be entertained and instructed by it.

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SPECIAL ARTICLES

A FATAL DISEASE OF PIGEONS CAUSED BY THE VIRUS OF THE EASTERN VARIETY OF EQUINE ENCEPHALOMYELITIS

DURING the recent epidemic of equine encephalomyelitis in southeastern Massachusetts, a number of human cases of encephalitis were observed, which were shown by Fothergill, Dingle, Farber and Connerley[1] and by Webster and Wright[2] to have been due to the virus of the Eastern variety of equine encephalomyelitis. As part of our investigation of the human disease, it became of importance to consider the possibility of other host reservoirs of the virus. We were informed by a number of pigeon breeders residing in the area where the horse disease existed that during the period of the equine epidemic they had suffered unusual losses in their flocks both of special breeding stock and of the common, domestic pigeon, the species so numerous in our cities. Indeed, one of these breeders made the interesting observation to us by letter that his "losses of pigeons began to cease as soon as the cold weather set in."

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[1] L. D. Fothergill, J. H. Dingle, S. Farber and M. L. Connerley, *New Eng. Jour. Med.*, 219: 411, 1938.

[2] L. T. Webster and F. H. Wright, SCIENCE, 88: 305, 1938.

We received a dead pigeon on September 20, 1938, from a breeder whose residence was adjacent to a farm on which two horses had died of the equine disease. The brain was removed, triturated in sterile sea sand, and suspended in 10.0 cc of infusion broth. After centrifugation, part of the supernatant liquid was filtered through a Berkefeld V filter. Young albino Swiss mice were injected intracerebrally with both filtered and unfiltered material (four animals in each group). All these mice died in 48 to 96 hours, having exhibited symptoms similar to those observed in mice infected with the equine virus of the Eastern variety. Bacteriological cultures of the pigeon brain suspension before injection and of the brains of the dead mice were sterile. Subsequent experiments confirmed the filterability of the infectious agent.

The identification of the pigeon virus was determined by intracerebral injection of guinea pigs previously immunized[3] against the Eastern and the Western varieties of virus, and in normal controls. Each animal received a dose of 0.15 cc of a 1:1000 dilution of mouse-brain passage virus. Of six guinea pigs immunized against the Eastern virus, two died, and from one of these we were unable to isolate the virus; the other four remained well and showed no symptoms. Two animals immunized against the Western virus and all six controls died. From one of the guinea pigs previously immunized with the Western virus, and from two of the controls, the virus was again recovered in mice. We conclude from this experiment that the virus isolated from the pigeon was the virus of the Eastern variety of equine encephalomyelitis.

Pigeons were shown to be susceptible to the virus obtained directly from the original pigeon, following intracerebral inoculation. In other experiments, pigeons were shown to be susceptible to the strain of the Eastern variety of equine virus isolated from the brain tissue of the human case elsewhere described.

Giltner and Shahan[4] first demonstrated the susceptibility of pigeons to experimental inoculation of equine encephalomyelitis virus (probably Western type). These authors and, later, Ten Broeck, Hurst and Traub,[5] suggested the possibility of pigeons as host reservoirs of the virus. The susceptibility of a number of species of birds to experimental inoculation of the virus was demonstrated by Remlinger and Bailly.[6] We have been unable to find any report of the isolation of this virus from pigeons dying from natural infection by it.

Summary: The virus of the Eastern variety of equine encephalomyelitis has been recovered from the brain of a pigeon[7] which had spontaneously contracted the disease in an area where equine encephalomyelitis was prevalent among horses.

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THE DEMONSTRATION OF PHAGE PRECURSOR IN THE BACTERIAL CELL[1]

In their original study of the kinetics of the phage-bacterium reaction, Krueger and Northrop[2] found bacterial growth to be the essential conditioning factor for phage production. Under the conditions of their experiments any interference with bacterial growth was accompanied by a corresponding reduction in phage formation as stated in the equation:

$$\frac{P}{P_o} = \left(\frac{B}{B_o}\right)^n$$

where P = [phage] at any time, P_o = initial [phage], B = [bacteria] at any time and B_o = initial [bacteria].

More recently Krueger and Baldwin[3] have reported experimental evidence for the production of phage according to the reaction: phage precursor + phage→phage. The precursor, apparently a normal cell metabolite, was obtained in ultrafiltrates of growing phage-susceptible cell suspensions. The essential reaction then is analogous to the autocatalytic transformation of inactive enzyme precursor into active enzyme upon the addition of small amounts of the active form to a solution of the precursor, *e.g.*, trypsinogen + trypsin→trypsin. The detection of phage precursor led to the conclusion that precursor formation, rather than bacterial growth as such, should condition phage production and that the apparent role of bacterial growth is due to the fact that both these expressions of cellular metabolism have nearly identical optimal milieus.

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[3] We are indebted to Dr. R. W. G. Wyckoff and to Lt. Col. Raymond A. Kelser for providing some of the immune guinea pigs. Others were immunized by ourselves with chick-membrane vaccine kindly furnished by the Lederle Laboratories.

[4] L. T. Giltner and M. S. Shahan, Science, 78: 63, 1933.

[5] C. Ten Broeck, E. W. Hurst and E. Traub, *Jour. Exp. Med.*, 62: 677, 1935.

[6] P. Remlinger and J. Bailly, *Compt. rend. Soc. de Biol.*, 121: 146, 1936; *ibid.*, 122: 518; *ibid.*, 123: 562.

[7] Our findings in pigeons were briefly mentioned, with our permission, by Dr. Roy Feemster in an address before the American Public Health Association meeting in Kansas City, on October 26, and will be published in the *American Journal of Public Health.* They were likewise referred to by one of us (L.D.F.) in an address before a meeting of the the New England Veterinary Association in Boston, on October 26.

[1] The experimental work cited has been supported by grants-in-aid from the American Medical Association, the Research Corporation of New York and from various interested friends.

[2] A. P. Krueger and J. H. Northrop, *Jour. Gen. Physiol.*, 14: 223, 1930.

[3] A. P. Krueger and D. M. Baldwin, *Proc. Soc. Exp. Biol. and Med.*, 37: 393-395, 1937.

Experimentally Krueger and Fong[4] found it possible, by adjusting the pH and temperature of phage-bacteria mixtures, to completely inhibit bacterial reproduction, while phage formation continued. There is some question as to the theoretical significance of these results, however, inasmuch as the method employed for detecting Δ [bacteria] was not highly sensitive. Because of this and also because the yields of phage precursor have been both limited and irregular, we have sought a means of studying the precursor-phage reaction in the cell. The accumulated data offer excellent evidence for the existence of phage precursor within the bacterium and likewise for the dissociation of phage production and cell growth.

To demonstrate intracellular phage precursor we prepare "activated" suspensions of staphylococci by growing the organisms in a highly oxygenated medium. The activation process requires some two hours, after which the cells are separated from the medium, resuspended in Locke's solution and maintained at 5° C. for two hours in order to rule out the possibility of bacterial growth during subsequent reactions with phage. To demonstrate the precursor, 4 ml of activated cell suspension containing 5×10^8 bacteria/ml is added to 1 ml of phage diluted with Locke's solution to contain 1×10^9 activity units/ml. The initial phage concentration of the mixture, therefore, is 2×10^8 activity units/ml. The mixture is kept for five minutes at 5° C. and is then promptly titrated for total phage content. The end titre is found to be 2×10^9 phage units/ml, whereas that of a control (non-activated bacteria prepared from a 16-hour agar culture) is 2×10^8 units/ml.

A detailed study of the reaction occurring when phage is added to activated bacteria will be reported elsewhere. The data indicate that:

(*a*) Phage precursor is produced by the actively metabolizing bacterium and apparently is present on the cell surface.

(*b*) Precursor production is enhanced by conditions which favor general cell metabolism. Cell growth and phage formation as a consequence present a pseudo-relationship, for both are dependent upon similar environmental factors. The activation process mentioned above merely serves to induce the production of relatively large amounts of precursor before the cells are put into a resting state by storage in Locke's solution at 5° C.

(*c*) Precursor is transformed into phage within two to four minutes after the addition of phage to activated cell suspensions. The precursor content of activated cells is maintained for a period of 6 to 24 hours.

(*d*) Phage precursor is more thermolabile than the bacterial cell. It is possible to destroy the precursor content of the cell by heat and still keep the cell alive.

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[4] A. P. Krueger and Jacob Fong, *Jour. Gen. Physiol.*, 21: 137–150, 1937.

THE HYDROLYSIS OF STEROL GLYCOSIDES BY EMULSION

IT has been shown by Odell and Marrian[1] that pregnanediol, as well as other sterol sex hormones, occurs in the urine conjugated with glycuronic acid.

A majority of the methods so far employed for the isolation or estimation of sex hormones depend upon acid or alkali hydrolysis of the glycosidal linkage.[1, 2] While most investigators feel that the sterol sex hormones are not destroyed to any appreciable extent by such treatment, proof that such is the case is inconclusive.

Venning[3] has proposed a method for the isolation of pregnanediol (as sodium pregnanediol glycuronate) by which she has determined the pregnanediol content of human pregnancy urine (eighth month) to be from 20 to 25 milligrams per liter of urine (equivalent to from 40 to 60 milligrams of pregnanediol glycuronate). Other investigators have reported findings of the same order of magnitude.

Since it has been suggested that pregnanediol glycuronate might be a beta glycoside,[3] it occurred to the authors that hydrolysis of the glycuronate might be effected rapidly, and without destruction of pregnanediol, by the enzyme emulsin.

Preliminary experiments have shown that pregnanediol glycuronate is hydrolyzed rapidly by low concentrations of emulsin at a pH of approximately 6.0, the hydrolysis being carried out directly in the urine. This may be considered proof that pregnanediol glycuronate is a beta glycoside. Isolation of the pregnanediol freed by this method and extracted from the urine by a modification of the original process of Katzman and Doisy[4] yields a product of high purity without additional purification (m.p. 235° C. uncorr.). Treated in this manner, second to eighth month human pregnancy urine yields from 40 to 50 milligrams of pure crystalline pregnanediol per liter; or approximately twice the amount previously reported by other investigators.

Full details of this investigation will appear soon in the literature.

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[1] Odell and Marrian, *Biochem. Jour.*, 30: 9, 1936.

[2] Marker, *Jour. Amer. Chem. Soc.*, 60: 2442, 1938.

[3] Venning, *Proc. Soc. of Exp. Biol. and Med.*, 34: 792, 1936.

[4] Katzman and Doisy, *Jour. Biochem.*, 98: 739, 1932.

AN EFFECT OF LIPID FEEDING UPON VITAMIN C EXCRETION BY THE RAT[1,2]

DURING the past year we have been searching for the biological precursor of vitamin C (ascorbic acid) by a technique that has given clear-cut and consistent results—that is, the results are clearly positive or negative in each case. The earlier published suggestions that mannose and certain other substances might serve as precursors of ascorbic acid could not be verified in our own or other laboratories during the past six years. Meanwhile, identification of the vitamin as a single substance and the development of sensitive, quantitative methods of analysis have led to a greater appreciation of the vitamin's probable wide-spread importance in cellular processes. It is now evident that ascorbic acid *can be synthesized by practically all plants and animals*, with the exception of guinea pigs, man and the other primates. Therefore, even though only the latter types are subject to scurvy, it is reasonable to assume that the vitamin has definite, essential functions in all the higher plants and animals (the lower, or less highly organized types, have not been investigated extensively). From a chemical point of view the role of the vitamin *in vivo* is essentially unknown, even though many empirical physiological relationships are clearly recognized.

The technique that we have used is essentially as follows. Young or adult albino rats are kept in raised-bottom cages of the usual type, below which a fine screen and funnel serve to collect the urine into small vials. The vials contain enough metaphosphoric acid to provide a final concentration of approximately 3 per cent. The samples are removed and titrated once each day to provide a measure of vitamin excretion. Animals fed a stock diet of Purina chow or Sherman's diet No. 13 show a sharp drop in vitamin C excretion during inanition, or a more gradual drop when placed on a diet of condensed milk. Hence, after a short period of inanition (3 to 4 days) and an additional period (generally 3 to 6 days) on condensed milk, they are in a suitable condition for assay purposes. The animals are then fed the test supplement plus a basal diet of condensed milk.

The common purified foodstuffs such as sugars, proteins and oils do not affect the rate of vitamin C excretion. Oats, oat oil, the unsaponifiable matter from oat oil and halibut liver oil quickly induce a high rate of excretion that may readily exceed 2 mg per day. Comparable results with respect to the time and extent of response are obtained by feeding the pure vitamin. Certain volatile fractions from liver oil and oat oil are especially active, and investigations are being continued for the purpose of checking the identity and structural relationships of the active materials from different sources. The fatty acids and common sterols are inactive.

The results are of interest, not only in relation to the biological synthesis of a vitamin, but also because of the novel effect of a lipid upon the synthesis of a carbohydrate (the vitamin, $C_6H_8O_6$, is essentially a sugar). Although the suggestion of this type of lipid-to-carbohydrate conversion has apparently never been made, there is considerable evidence in the literature to indicate that vitamin C is peculiarly related to the mitochondrial, adreno-cortical and carotenoid lipids.

It is possible that the lipid effect may be exerted through an indirect agency, such as by accelerating a synthesis from other substances, or by serving as a *protective agent against tissue destruction*. These phases of the problem are being investigated, but the weight of evidence at the present time favors the "precursor" interpretation.

The vitamin excretion has been verified by biological assays with guinea pigs, in addition to chemical titrations, so that there is no question concerning the identity or approximate quantity of the product excreted.

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PLANT VIRUS INHIBITORS PRODUCED BY MICROORGANISMS

IN a recent paper from this laboratory[1] it was shown that many bacteria and fungi were capable of inactivating the virus of ordinary tobacco mosaic, and that the time required for this action depended upon the organism used. It was also suggested at the time that the inactivation of the virus in the cultures was due to decomposition or digestion. The high comparative rate of inactivation of the virus by certain organisms such as *Aerobacter aerogenes* (Kruse) Bergey *et al.* and *Aspergillus niger* Van Tiegham stimulated further investigation of their behavior. It soon became evident that these organisms differed from most microorganisms with respect to type of inactivation in that they were capable of producing a substance (or substances) in culture which when added to an extract of tobacco mosaic is immediately inhibitory to the infectivity of the virus. This substance is not toxic to living matter in the usual sense when used on bacterial, fungal or higher plant cultures, and in this respect, resembles charcoal, Phytolacca juice,[2] dry soil and trypsin, in its action on the virus. Whether or not the substance is to be regarded as a virus inactivator or an inhibitor to host infection as reported by Stanley for trypsin[3] has not been fully determined. Since the inhibitory effects on infectivity is instantaneous it suggests that the inactivation of the virus in the instance of the two above organisms grown in culture can not be attributed to decomposition or digestion. Efforts at precipitation and purification have not been successful. The substance may be concentrated appreciably by evaporation of the culture medium, the inactivator being tolerant to drying and to heat, partly withstanding 100° C. for several hours. In a dried broth culture the product is normally active at 0.1 per cent. water solution and retains most of its activity at 0.01 per cent. concentration. A normal concentration will completely inactivate an equal volume of undiluted extract of ordinary tobacco mosaic. It is equally effective on several other plant viruses. The inactivator passes bacterial proof filters but with considerable reduction in potency. The substance retains its activity for months in either the original culture, a heat-sterilized culture or in a state of desiccation. It will also withstand high concentrations of alcohol, chloroform, mercuric chloride and charcoal. The substance differs strikingly from the Phytolacca juice and trypsin inhibitors in several respects, as for example in its ability to tolerate higher temperatures. There is therefore probably no chemical relationship between these peculiar virus inhibitors.

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[1] Research Publication No. 371, from the Department of Chemistry, University of Pittsburgh.

[2] This investigation was made possible by a research grant from the Buhl Foundation.

[1] J. Johnson and I. A. Hoggan, *Phytopath.*, 27: 1014–1027, 1937.

[2] B. M. Duggar and J. K. Armstrong, *Ann. Mo. Bot. Garden*, 12: 359–366, 1925.

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SCIENTIFIC APPARATUS AND LABORATORY METHODS

THE USE OF PLASTIC MATERIALS FOR OPERATIONS ON AMPHIBIAN EMBRYOS

OPERATIONS on amphibian embryos are usually carried out in black wax dishes, while grafts are held in place by means of glass rod "bridges."[1] When these devices are employed for transplantation experiments on the hind limb of Amblystoma,[2] however, it is usually difficult to hold the embryos firmly since the wax can not be molded about them *in situ;* nor is it always possible to adjust the glass bridges to the proper contact and pressure for good healing.

The following materials and devices have been developed[3] to provide more adequate equipment for operations on Amblystoma embryos. They have been used successfully, with minor improvements, for five seasons and have been found adaptable to a wide variety of experiments with both anurans[4] and urodeles.

A. OPERATING DISHES

Various types of waxes and modeling clays have been tested to find a non-toxic material which can be molded readily and into which pins can be inserted easily and firmly. Most waxes are unsuitable for these purposes, although colorless "Rainbow Wax" (American Art Clay Company) works easily but lacks the firmness of clays. Stone[5] also reports satisfactory results from molding white refined beeswax. On the other hand, almost all clay modeling materials can be molded readily under the solution used for operating and are sufficiently firm, but many of them are toxic, especially those with noticeable odor or color.

To date, uncolored or gray Permoplast Modeling Clay (made of China clay, petrolatum and glycerine—American Art Clay Company, Indianapolis, Ind.) has been found most satisfactory for retaining the embryos without injury and for holding the graft covers securely during the progress of healing.

The operating dish is made by filling a Stender preparation dish of 50 or 60 mm diameter about half full of the modeling material. In performing the operation a depression is made in the plastic material by means of a blunt glass stylus, while the embryo lies alongside for comparison of size and shape. The embryo is then inserted into the cavity and the material pressed around it, or tiny spurs rolled up over it by means of a spear-shaped needle or glass rod. When the embryo is ready to be removed, it may be freed without injury by pushing or scooping away the surrounding material.

B. GRAFT COVERS

Graft covers with pin supports have been devised to hold the transplanted tissue in place during healing. The cover proper is made of some clear transparent plastic sheet material such as du Pont's Lucite, Plastacele or Pyralin of .090 inch to .125 inch thickness. The pin supports are fashioned from small gold-plated safety pins (Fig. 1, A) or large (No. 7) non-corrosive insect pins. The safety pins are preferable, however, since the clasps form convenient "handles."

The graft covers are made by sawing a piece of the sheeting into small rectangular blocks of about ¾ inch x ⅜ inch each. A fine hole is then drilled through each end of the block, using a No. 70 or 71 wire gauge drill, depending on the diameter of the pin. The edges of the block are then smoothed with a sharp blade, but care should be taken not to mar the upper and lower surfaces where clear visibility is necessary. The block may also be trimmed away to form a surface of contact of any shape or size desired.

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[3] W. M. Stanley, *Phytopath.*, 24: 1055–1085, 1934.

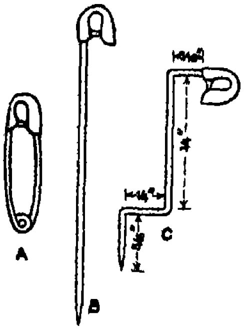
[1] R. G. Harrison, *Jour. Exp. Zool.*, 32: 6, 1921.

[2] W. A. Stultz, *Jour. Exp. Zool.*, 72: 330, 1936.

[3] W. A. Stultz, *Anat. Rec.*, 64: Suppl. no. 1, 43, 1935.

[4] K. A. Youngstrom, *Jour. Comp. Neur.*, 68: 353, 1938.

[5] L. S. Stone, *Proc. Soc. Exp. Biol. and Med.*, 31: 1084, 1934.



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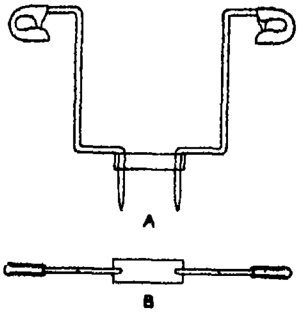

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FIG. 1. Graft cover support made from small safety pin (A) straightened out (B) and bent at three points (C). ×1.

FIG. 2. Completed graft cover viewed from the side (A) and from above (B). ×1.

The supports are made by first straightening out the safety pins (Fig. 1, B). Each pin is then bent to form three alternating right angles (Fig. 1, C). The pins are then driven tightly through the holes in the block (Fig. 2). They may also be cemented in place.

The graft cover is used by centering it over the transplant and pressing the pin points into the plastic material until the cover rests evenly on the graft with sufficient pressure to hold it in place during healing.

This type of graft cover has the advantages of affording clear vision and of being easily manipulated, perfectly adjustable and of standard construction so that any one cover may be used for any graft, irrespective of the size or position of the embryo or the location of the transplant.

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A CULTURE SLIDE FOR DARK-FIELD MICROSCOPY

THE slide has a central circular stage about 3 mm in diameter which is surrounded by a circular moat approximately 0.9 mm deep and 4.5 mm wide at the top. The wall slopes away from the central stage so that the stage is at the upper surface of a truncated cone with a broad base. At a slight distance from the outer margin of the moat, a second narrow and shallow groove is cut in the glass, entirely encircling the moat. The surface of the central stage, the glass surface between the moat and the encircling groove, and the glass surface outside the groove are all on the same level so that a thin coverslip applied to the slide leaves only a capillary space between the under surface of the coverslip and the surface of the stage, while there remains a considerable space in the moat for culture medium to supply pabulum. The outer circular groove guards against contact of this medium with the vaseline or paraffin used for sealing the edge of the coverslip.

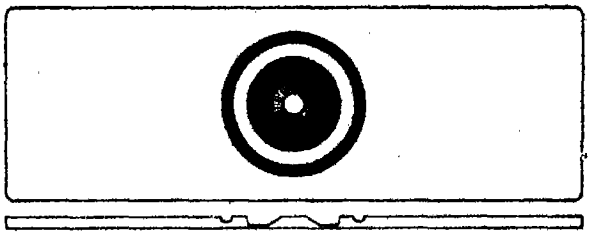

FIG. 1.

The upper drawing shows the pattern of the face of the slide. Below it is the pattern of the profile view of the median longitudinal section.

The measurements and the level of the stage may be varied in different models to meet special needs. At the present time two models are available. One of these is 1.15 to 1.20 mm thick for use with the Zeiss cardioid condenser and the paraboloid condenser of the Spencer Lens Company, and the other is 1.30 to 1.40 mm thick for use with the paraboloid condenser of Bausch and Lomb.

The slides are being made by C. A. Hausser and Son and may be obtained through Arthur H. Thomas Company, 230 South Seventh Street, Philadelphia, Penna.

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SELENOLOGY AND COSMOGEOLOGY

COSMIC AND GEOLOGIC IMPORT OF THE LUNAR FEATURES

By Dr. HERMAN L. FAIRCHILD

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APOLOGY: In slight excuse for trespassing in the astronomic field it may be said that a geologist, cooperating with an astronomer, showed the fallacy of the nebular hypothesis, which had been cherished by astronomers and selenographers for more than a century; and that a student in geology may have some reasonable ideas in selenology.

Thesis: The basins and pittings of the lunar surface are impact craters and are ocular confirmation of the view that the planets and satellites were built by cold accretion. This implies acceptance of the planetesimal hypothesis of Chamberlin and Moulton. The genesis, growth, history and structure of the earth and moon are here considered from the planetesimal view-point.

Ever since Galileo first peeked at the moon through his crude telescope, the lunar surface has been perhaps the most singular, fascinating and puzzling of telescopic objects. Galileo's surprise and delight have been reexperienced by all observers, and for four centuries selenography has been a favorite pastime for sky-gazers. Description and portrayal of the so-called craters and of the plains, mountains and the many peculiar features make an extensive literature. In recent time photography has largely displaced pen and pencil. Naturally the moon has been the subject of much speculation and imaginings and the cause of superstition and mental aberration. Scientific literature includes much lunar description that is unscientific and even unreasonable. The most pretentious treatise on the moon in American literature argues for the existence on the moon of atmosphere, snow, ice and vegetation. This ignores the heated condition of the surface during the long lunar day. It would be a new sort of vegetation that could endure the great extremes of temperature between the lunar day and night. With all this interest in and study of the moon, the origin of its striking features yet remains in question.

LUNAR CRATERS

The most important error in the lunar study relates to the so-called craters. Until later years the tens of thousands of pittings and circular depressions have been quite universally regarded as of explosive or volcanic origin. The volcanic conception was naturally involved in the erroneous nebular hypothesis to be described below. Volcanism seemed to be the natural or even inevitable stage in the cooling of a molten globe. However, with the exception of the circular form of the basins and the supposed resemblance of the lunar substance to volcanic scoria, it is questioned if there is a single feature of the moon's surface that simulates or illustrates volcanism as we find this upon the earth. A casual resemblance of the lunar features to terrestrial volcanic craters was accepted as proof of volcanism, and the negative facts and philosophy were neglected. The evidence and argument in negation of lunar volcanism and the rational substitute will be considered later in this writing. The study of the moon, selenology, has been retarded by adherence to a mistaken conception of planetary genesis. The same is emphatically true of geology, which held the belief that the earth was originally a molten, incandescent sphere. Most serious problems in geology refer, in their final analysis, to the manner of formation of the earth. It is desirable now to review briefly the astronomic element in our earth science.

NEBULAR, LAPLACIAN, HYPOTHESIS

This hypothesis postulated that the material of the solar system was originally a discoid or wheel-shaped nebula of superheated gas with rapid revolution. By centrifugal force successive rings were detached, which in some manner evolved the planets; the sun being the undistributed central mass. This hypothesis required that all the planets, planetoids and satellites should pass from a superheated gaseous condition through a molten state. This conception, which involved a molten incandescent earth, was universally accepted for a hundred years down to the close of the last century. Yet the conception was not true. It remained for a geologist with the collaboration of an astronomer to prove its fallacy. They found that the Laplacian conception failed at every point where it was tested by modern physics.

PLANETESIMAL HYPOTHESIS

As a substitute for the mistaken hypothesis Professor T. C. Chamberlin with Professor F. R. Moulton formulated in the year 1900 the planetesimal hypothesis. This new conception holds that the materials which constitute the planets, planetoids and satellites were derived from the sun through gravitational effect by a passing star. The combination of forces and movements involved in the dynamic encounter threw the expelled and disseminated solar material into orbital revolution around the parent body.

Under this hypothesis the planets and satellites, including of course the earth and moon, were formed by a process of cold accretion. They were built up from nuclei by ingathering through overtake and intake of solar material, bodies large and small, the "planetesimals" all traveling in the same general direction in various orbits about the sun.

OTHER COSMIC HYPOTHESES

The astronomers and astrophysicists finally accepted the death sentence on the Laplacian conception; and some of them soon formulated their own hypotheses as rivals or substitutes for the planetesimal. During the last thirty-five years the considerable literature on the subject records many changes and revisions in the hypotheses. Like the planetesimal, these conceptions are all based on assumptions.

In his recent book, "*The Solar System and Its Origin*," Professor H. N. Russell has briefly reviewed the several hypotheses of the genesis of the solar system and concludes with these words, "The most encouraging direction for this attempt would still appear to be in the modification of the hypothesis of an encounter." We may claim that the planetesimal hypothesis yet stands with the simplest assumption and the most reasonable sequence of process and events.

Our planetary system had a biparental origin. The father star passed on his way with calm indifference, leaving to the mother sun the responsibility of training her brood and bringing it into the present orderly and stable system, the solar family, as Chamberlin aptly called it.

ORIGIN OF THE EARTH

The astronomic philosophy covering the origin of the planetary system has relation to fundamental geologic philosophy.

The conception of an originally molten earth was inherent in and necessitated by the nebular hypothesis, and down to forty years ago our earth science was based on the conception of an originally molten globe. With the passing of the nebular hypothesis the molten-globe idea should have been discarded as having no factual basis. Yet the idea was so imbedded in scientific thought and literature that it survives and yet appears in scientific writings.

The question might be asked: Could not the earth have been originally molten under some conception of the origin of the planetary system other than the nebular hypothesis? Under any conception of planetary origin thus far proposed the answer is fairly negative. It is now generally recognized that the planetary system is composed of materials derived from the sun and that its present form is the product of an organizing process acting through vast eons of time. Concerning the origin of the earth only two conditions seem possible. Either it was born with *full volume and mass or else it grew by some manner* of accretion. Whatever was its origin and history the same must be attributed to all the other planets. The earth could not have been unique.

If the earth, derived from the solar atmosphere, held at once as a gaseous globe all the substance of the present earth, then a similar condition was true of all the planets. Such initial concentration of nearly all the substance of the planetary system is not only highly improbable, but it would be quite impossible to trace its evolution into the dynamics and structure of the existing system.

If the earth was built by accretion and yet was molten when completed, then the ingathered materials had retained their solar heat during all the vast lapse of time necessary for the accretionary process. This seems impossible. The solar substance drawn from, or expelled from the sun was thrown far out into interstellar space. (Pluto is over three and one-half billion miles from the sun.) This gaseous material was subjected to the absolute zero temperature in the vacuum of space. It must promptly have been condensed to fluid and eventually to the solid state. Astronomic science does not truly favor in fact or philosophy the conception of a molten earth.

Discussion of the genesis of the solar system during the past thirty-seven years has left the Chamberlin-Moulton planetesimal hypothesis as the one with the least assumption and the most reasonable, simple and satisfactory conception yet proposed, and the one most in harmony with geologic facts. Geology favors the cold accretion theory.

ABSENCE OF LUNAR VOLCANISM

The many singular features of the lunar surface were attributed to volcanism in the absence of any other scientific explanation, and the physical characters in negation of volcanism were not properly considered. One of the latter relates to the moon's structure.

The earth and the moon, built of planetesimals, have similar composition. The only materials on the earth with which the moon's substance may be compared, and only by ocular and spectroscopic means, are the volcanic scoria and lavas, which do have superficial resemblances. The exterior mass of the earth, to a depth of quite two thousand miles, has been subjected to the alterative work of water and air, producing materials and structures entirely absent on the moon. The lunar substance is the unoxidized, unhydrated, unaltered planetesimal stuff. The name "lunite" will now be used.

The earth's exterior mass is compact, solid rock. Through fissures in the crust and by outflow of molten magma some large part of the earth's imprisoned gases, the magmatic volatiles, found slow and quiet escape. Some part escaped imprisonment by violence, producing volcanoes. On the earth's entire surface volcanism is a rare and widely scattered feature. Unlike the earth the moon has no compact rock strata. Being gravitationally incompetent to hold gases on its surface, it never had an atmosphere and ocean. Whatever was the genesis of the moon, its surface material has never been compacted by water action, sedimentation.

The moon's substance has been generally described as scoria. Temperature measurements indicate that the material is highly porous. It thus appears that the surface material is relatively incoherent. Its nature is evidently what would be expected from accumulation through planetesimal accretion. Undoubtedly the moon inherited in its solar substance its proper share of volatile elements, and these volatiles must have found easy escape. The magmatic vapors of the lunar body were able to escape with relative ease through the uncompacted surficial mass, and no cause or condition is found for explosive phenomena.

METEOR CRATER

The only feature on the earth with which the lunar craters may be compared is Meteor Crater in north-central Arizona.[1] Involving complex problems in kinetics, mechanics, meteorology and geology, this was declared, by the great Arrhenius, to be the most interesting spot on the earth.

The present concern is with the impacting body, meteorite or comet, and the disposition of its energy and mass, and also with the effects and phenomena of the impact. This requires a fair description of the crater-basin in all its features.

We do not know if the impacting body in this Arizona encounter was a member of our solar system, only a belated planetesimal, or was a visitor from interstellar space arriving in haste unannounced and without credentials.

This crater is a great circular basin, in hard rock

[1] G. K. Gilbert, SCIENCE, 3, 1896; D. M. Barringer, *Proc. Acad. Nat. Sci. Phila.*, December, 1905; B. C. Tilghman, *ibid.*; H. L. Fairchild, Geol. Soc. Amer., *Bull.* 18, 1907, and SCIENCE, 72, 1930; Eliot Blackwelder, SCIENCE, 76, 1932; Clyde Fisher, Amer. Mus. Nat. Hist., Guide Leaflet Series, No. 92.

strata, now 4,000 feet in diameter and with a depth of 600 feet, of which about 150 feet is due to uptilt of the rock rim. An inwash filling has average depth of about 80 feet. The rock strata belong in the Grand Canyon series. In descending order, with approximate thickness they are, Moencopic red sandstone, 40 feet; Kaibab limestone, 260 feet; Coconino white sandstone, 950 feet.

At the time of impact the spaces and interstices of the upper strata were filled with air and water, while the Coconino sandstone was saturated with water.

The tremendous concussion shivered the rocks to dust for a depth 1,200 feet or more.

The underground form of the shivered rock was that of a "cone of percussion." Taking the angle of the cone as ninety degrees and assuming that the impacted area on the surface of the plain was a circle of 1,000 feet diameter, then the downward enlargement of the cone would, at the depth of 1,200 feet, give a diameter of quite 3,500 feet.

The short-wave vibrations pulverized the quartz grains of the Coconino to microscopic dust and produced heat sufficient to fuse some of the quartz into silica glass.

The water in the pulverized and vibrating mass was instantly changed to superheated steam, and the violent expansion lifted not only the crushed rock but also the overhanging shattered strata and piled part of the mass on the plain, while the larger part fell back into the instantly created basin.

Further explosive effect uptilted the topping strata of the basin rim. During subsequent time the upper portion of the walls has receded somewhat by weathering, as indicated by the talus slopes. The remnant of the tilted strata has a maximum upslant of about 150 feet.

The ring of rock debris on the crater rim is a great ridge with a basal width of nearly one-half mile. It consists of quartz flour, the powdered Coconino sandstone and fragments of Kaibab limestone. Larger blocks of the latter have been estimated in weight up to 4,000 tons, and huge blocks of this limestone lie a mile from the crater. The ridge of debris has been reduced in volume by rain and wind erosion.

The amount and weight of rock expelled from the crater-basin is fairly determined. Drilling in the crater penetrated 800 feet down to the red Supai sandstone, of which 80 feet is inwash filling. The 720 feet deducted from 1,250 feet, the depth of the three rock formations, leaves 530 feet as the depth of the primitive crater basin below the surface of the plain. The same figure is found by deducting 150 feet of uptilt of the rock rim from the 600 feet of basin depth and adding the 80 feet of inwash filling.

The expelled rock was a discoid of stone with diameter about 3,500 feet and thickness of 530 feet. The weight was about 400,000,000 tons. The energy expended in tossing this mass to the plain was a minor portion of the energy transferred from the meteorite to the earth.

TRANSFORMATION OF ENERGY

The dynamics involved in the production of the crater give a fine illustration in conservation and transformation of energy. The resident energy in the falling meteorite, mass-motion, was partly transferred to the earth and transformed into vibratory motion. This was all transformed into molecular motion or heat and this was retransformed through steam expansion into mass motion, the lifting of the great mass of rock through hundreds of feet against the force of gravity. To-day part of that energy is stored in the great ring of rock rubbish on the rim of the crater as potential energy, by virtue of its uplifted position.

All the kinetic energy of the meteorite was not transferred to the earth, as a large part was used in its self-explosion, noted below. The collision, the transformation of energy, the explosion deep in the earth and the bursting of the meteorite all occurred in a second of time.

Some of the substance of the meteorite, exploding simultaneously with the crater eruption, is found in the crater filling.

CANYON DIABLO IRONS

On the plain surrounding Meteor Crater in a radius of four to five miles have been found thousands of nickel-iron meteorites, the Canyon Diablo siderites. They range in weight from 1,406 pounds down to tiny individuals of a few grams. Their character, number, size and association make this "fall the most famous and interesting in the literature of meteorites."

The irregular form of the irons, with great angularity and sharp cusps and ridges, shows that they were nodular accretions in a non-metallic substance, probably meteoritic stone. It appears likely that most if not all solid iron meteorites were originally inclusions in stony matrix. The Willamette iron in the American Museum of Natural History with its perforations is a fine example. The genetic relationship of the Canyon Diablo irons to Meteor Crater is positive. The irons were nodular inclusions in either the giant meteorite or in stony masses which were attached to the great nucleus. Stone-like meteorites, the aerolites, are highly perishable, and exposed to air and water dissolve and disappear. The giant meteorite and its companions, if it had such, undoubtedly were largely stony substance which disappeared thousands of years ago, leaving the irons and the crater features as the record. It has been suggested that the irons were unattached or free companions of the meteorite. This idea probably is in error. The irons with their stony casings did not fall directly from the sky or vertically. Such fall would imply that the thousands of bodies had been traveling through space as a great open swarm or cluster ten miles in diameter; which would seem impossible. Gravitation would draw the bodies together into a close, compact mass. Atmospheric obstruction during their fall to the earth could not so widely separate the units. The impact of such assumed close aggregation would have quite the same effect as if it were one solid body. The kinetic energy changed instantly to heat produced expansion with violent explosion which distributed the entire mass over a circle of five miles radius. The sharp edges and angles of the nickel-irons prove that they were not heated sufficiently to produce any fusion. This fact is also emphasized by the occurrence of innumerable minute irons.

FATE OF THE METEORITE

The fate of the meteorite is the interesting and important question. This has already been suggested in the explanation of the Canyon Diablo irons.

Exploration of the crater was made in the belief that a great nickel-iron mass lay buried. This is mechanically impossible.

Physicists claim that in the sudden stoppage of a great meteorite with planetary velocity, the kinetic energy, mass motion, would produce heat sufficient to vaporize the mass. This appears to assume that all the energy is expended upon the mass itself. But at Meteor Crater all the enormous energy represented in the crushing of the strata and the expulsion to produce the basin was transformed energy supplied by the meteorite. The explosion of the meteorite was in quite the same instant of time as the impact and concussion. A moment later came the piling on the plain of the disrupted rock. It is probable that some part of the meteorite lies beneath the great ring of rock debris surrounding the crater. Such burial probably has preserved some meteoritic stone of which the meteorite was mostly composed.

In any physical and mathematical study of the transformed energy the enormous amount consumed or utilized in the expansion, and in the projection and spreading of the mass over the area of ten miles in diameter, must be recognized, as well as that utilized in the production of the crater phenomena.

If the impacting body was a spherical siderolite, of 1,000 feet diameter, and with an average density of 4.0, then its weight was 65,450,000 tons.

LUNAR CRATERS OF IMPACT ORIGIN

The lunar craters are mostly deep depressions below the general surface, even to a depth of 10,000 feet, and it is now recognized that the lunar depressions are impact craters, produced by the infall of bodies of undetermined nature and velocity. Many of the craters have a central cone, a feature readily duplicated in experimentation. The sharp-pointed or spire form is undoubtedly due to spalling or exfoliation of the massive original columns, caused by expansion and contraction of the lunite under the extremes of temperature.

The multitude of craters and ringed plains many thousands in number, sometimes closely crowded and overlapping and of varying size up to fifty miles or more in diameter, is a remarkable and strange display, but this is precisely the condition and appearance theoretically required during the early stage of planetary growth by ingathering of planetesimals.[2]

The moon is ocular evidence for the cold accretion element in the planetesimal hypothesis.

FATE OF LUNAR PLANETESIMALS

Between Meteor Crater and the lunar impact craters there are great differences, due to the uncompacted character of the lunar surface material and to the varying size of its impact features, ranging from barely visible pittings up to ringed plains with diameter of sixty miles. Planetesimals are supposed to have ranged in size from dust particles to bodies the size of planetoids (asteroids). The most striking feature is the close crowding and even overlapping of hundreds of craters, yet retaining perfect form. The absence of non-circular forms has been noted as an objection to the impact theory.

Two significant elements in the lunar landscape are the high topographic relief of the crater ridges and basins, and the clearness of the surface details, especially the irregularity and asperity of the circular ridges. If the infalling planetesimals were vaporized, then in the areas where the craters are closely crowded, the thick mantle of precipitated planetesimal substance would certainly bury the surface details and at least partly fill the basins. Only the younger craters would remain uncovered and distinct. This appears definitely to rule out the conception of vaporization of the infalling bodies. The crater forms with the depth of the basin suggest that the planetesimal produced a splash in the uncompacted lunite and, passing downward with its energy transformed to heat, was engulfed as a molten body in the lunite; a revulsion producing the central cone. The velocity of the impacting body is an undetermined critical factor. It is assumed that all the planetesimals were traveling in the same general direction with the earth and moon, and were captured by the attraction of the planets in some sort of overtake and intake. The acceleration of the velocity of infall due to gravitation except on close approach was on the moon only one eightieth of that of the earth.

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[2] The term meteor refers to the atmosphere. A body falling through the atmosphere we call a meteor. As the moon had no atmosphere it had no meteors. For its accretionary infalls we have no better name than planetesimals.

The remarkable central cones are quite certainly an effect of the recoil, revulsion or upthrow of liquid or semi-liquid from violent disturbance. In experimentation this feature results with burial or engulfment of the missile. The level smooth floors of the majority of craters suggest liquidity.

From this brief study it would appear certain that the planetesimals were not vaporized. Their stoppage was unlike that of the Meteor Crater bolide. They plunged deeply into the incoherent lunite before their energy was entirely changed to heat. Free explosion in the deep inclusion was inhibited, but fusion occurred, of both the planetesimal and the enclosing lunite. Under this conception all the moon's substance passed through a state of fusion. This would give the lunite the dark color and resemblance to terrestrial lava and scoria.

Lunar Plains

The larger part of the moon's surface is comparatively or entirely destitute of craters. These relatively smooth areas were called "seas" or "maria," under the mistaken conception that the moon once had atmosphere and ocean. The striking contrast between areas covered with craters and adjacent areas quite or wholly destitute of craters would seem on first thought to be fatal to the accretion theory. The volcanic conception did not explain this discrepancy.

It must be supposed that the infalling planetesimals were quite impartially distributed over the lunar surface. The present difference must be due, not to unequal infall but to destruction of the impact features. For this we may not invoke external or cosmic agency but must recognize some force or process within the moon itself. An evident internal force is gravitation with condensation and contraction process. With a radial depth of over 1,000 miles and the loose texture of the lunite, there must have been considerable subsidence of the lunar surface. The maria are such areas of depression below the general surface. The large irregular areas, comparatively destitute of perfect impact features, yet carry many remnants of broken-down crater rims. They probably are the areas of surface subsidence since the moon became of age. The structure and behavior of the porous and brittle lunite were so different from that of the earth's solid crust that the peculiar mechanics are difficult of interpretation. It appears that some factors have largely but not entirely shattered or broken down the crater topography. A few craters in good form on the wide plains are record of planetesimal infall subsequent to the areal subsidence.

Some of the borders of the plains are depressed alongside of mountain ridges, a relation similar to differential vertical movement or faulting on the earth. Such relations are the natural effect of local subsidence.

The large circular areas, "ringed plains," probably are the impact areas of great planetesimals. The great variation in size of the records of impact, from minute pittings up to the "Mare Imbrium" 700 miles in diameter, is the normal record of planetesimal infall.

The variety of singular forms and markings on the lunar surface, never explained under volcanism, will probably find explanation as the peculiar effects of planetesimal impact and explosion.

Stages in the cosmic history of the lunite: 1. Existence in the sun for a near-eternity of time, as superheated vapors of all known elements. 2. Removal from the sun with distribution far out in interstellar space, with subjection to absolute zero temperature. 3. Motion in orbital revolution around the parent body, with loss of heat and condensation to liquid state. 4. Continued cooling and condensation to solid state, as planetesimals of size from molecules to masses like the asteroids. 5. Collision with the moon, probably producing a second state of fusion. 6. Cooling and condensation to solid lunite. 7. The latter infall exposed to human vision through 240,000 miles of space and subjected to human cogitation.

The Juvenile Earth

The earth had its inception, perhaps it might be called its embryonic stage, as one of the larger masses of the planetesimal swarm. It grew by drawing to itself the other and smaller planetesimals that drifted within the range of its gravitational control, through the crossing of their orbits.

An important question at once arises as to the temperature of the infantile earth. It may be conceded as a possibility that the initial mass had high temperature. Such conception would imply that either the mass or knot of superheated material which served as the nucleus of the young earth had retained its heat from the far time of solar outpouring or that the accretionary process began promptly after the dynamic encounter. This might explain, in part, the supposed present very high temperature of the earth's interior. However, the length of time that must have been required for the young earth to gather in any great amount of material would have allowed the smaller planetesimals, traveling through a vacuum and absolute zero temperature, to lose their heat. But the much greater immensity of time required for the larger growth quite certainly implies cold accretion.

Whatever was the temperature of the infantile earth, the planetesimals that formed it must have been similar in composition or substance to those which later built the mature earth. They contained all the various elements which compose the earth and its envelopes. This rules out the fanciful idea that the earth's core is nickel-iron and that the globe is built of concentric layers of diverse composition. This conception of concentric structure appears to rest in the belief in an originally molten globe which was inherent in the discarded nebular hypothesis.

The temperature of the earth's interior in distribution and degree and perhaps in cause is yet undetermined. We do not know if the earth is gaining or is losing heat. To determine this, precise measurements are required through centuries of time. If we may assume that physicists in the far future will have scientific curiosity and intelligence, it would be a fine bit of altruism for living geophysicists to make and record precise temperatures in deep drillings, in areas and under conditions that may be exactly duplicated centuries hence.

The juvenile period in the earth's development endured until the earth, in its growth, had acquired gravitative force sufficient to hold an atmosphere and primitive ocean. This ability was probably attained when the earth was about the size of Mars or with one ninth of its present mass. During this early stage of planetary growth, the surface of the planet probably was similar to that of the moon. The absence of air and water on the moon has permitted preservation of its surface features through the untold eons of time since the latest planetesimal bombardment. Under the planetesimal view the earth's core, about 4,000 miles diameter, is the original planetesimal substance, minus a large portion of its occluded gases, with chemical recombination and molecular readjustment under the enormous compression of eight ninths of the earth's mass.

GROWTH OF THE GLOBE

As the larger earth grew in mass and gravitative power it had increasing grasp on the flying planetesimals. The accretion was accelerated as long as the planetesimal supply was abundant; but the later growth of the globe had decreasing rate of accretion.

During the long stage of rapid accretion the earth's surface was in a state of great disturbance. The infalling planetesimals produced great splashing of the water bodies and tremendous concussion on the land areas.

The stony planetesimals that fell on the land surfaces were only less promptly hydrated and dissolved than were those which fell in the seas. With the planetesimal accumulation there was mingled the modified materials, volcanic eruptives and aqueous sediments. In deep burial the mixed materials were subjected to pressure, to heat and molecular reorganization. Eventually at lesser depths in the completed globe, this earth stuff has been highly differentiated into metallic segregations and the varieties of lava. A striking product of differentiation is found in the enormous amount of crystalline quartz, represented in all the metal-bearing quartz veins, in all the sandstones and quartzose rock and in the sand beaches of all the sea and lake shores of the world.

Great activity and change within and on the earth did not cease with the completion of its volume. It has continued restless like a living organism. Its dynamics and phenomena challenge human intelligence, and interesting and important problems are yet subjects of study. The writer, in bygone years, discussed geologic problems under the planetesimal conception.[3] One of those problems now requires further consideration, with change.

BEGINNING OF LIFE

If life was initiated through chemical and physical action from inorganic matter, under control of solar energy, the physical conditions in degree of heat and moisture requisite for life processes were fulfilled when the earth had acquired volume and depth of atmosphere sufficient to conserve the solar heat. The planet Mars, with a diameter of 4,215 miles, somewhat more than one half of the earth's diameter, has a thin atmosphere with some water, but it is doubtful if the surface temperature is sufficient for either initiation or development of life as we know it. Perhaps the suitable conditions existed on the earth when its diameter was 5,000 miles, and it had about one fourth of its present mass. However, an inhibiting factor must be recognized. While the earth was acquiring three fourths of its total mass the accretionary process probably was accelerated so that the surface was continually mantled with fresh accumulation. And whether the material was partly of large planetesimals producing great commotion, as noted above, or was largely of planetesimal dust and minute bodies, as Chamberlin suggested, the conditions were unfavorable for life development.

However, when the earth was nearly full size, the accretionary process was slow, and slowing, then the physical conditions certainly were favorable for life. That relatively short span of pregeologic time yet must have been sufficient for the evolution from primitive life-substance to the highly organized animal life represented in the oldest unaltered geologic deposits.

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[3] H. L. Fairchild, *American Geologist*, 33: 94–116, 1904; Geol. Soc. Amer., *Bull.* 15: 243–266, 1904; SCIENCE, 64: 365–371, 1926.

The philosophic claim is made that a single life germ might hold all the potency and promise of the entire organic world. But why restrict the beginning of life to a single germ? And why restrict the organic synthesis to one occasion? No good reason appears for supposing that the combination of forces on the surface of the mature earth was ever essentially unlike the present, and the circumstances which produced the primordial life must have been constant. This implies the probably continuous creation of organic matter to the present time. The amoeba either has retained its simplicity through countless generations of organic evolution during a vast length of time or it is of recent creation.

SCIENTIFIC EVENTS

INTELLECTUAL FREEDOM

The following manifesto signed by 1,284 scientific workers, of whom sixty-four were members of the National Academy of Sciences, and eighty-five college presidents and deans and directors of industrial laboratories and experiment stations, has been issued:

> In an article entitled "The Pragmatic and Dogmatic Spirit in Physics," which appeared in the April 30 issue of *Nature* (with strong editorial disapproval), wide publicity is given to the official Nazi position on science and scientific research. In essence the article is an attack on all theoretical physics, and, by obvious implication, on scientific theory in general. It introduces the official racialism of the Nazis to divide physicists into good, *i.e.*, non-theoretical and "Aryan," and bad, *i.e.*, theoretical and Jewish. Similar notions have appeared in many popular magazines and scientific journals in Germany, in the addresses and writings of the Minister of Education, of university rectors and deans, of scientists and non-scientists. Apart from racial theories, furthermore, science and art are subject to ruthless political censorship. These ideas have found concrete expression in the dismissal and persecution of over 1,600 teachers and scientists (by the fall of 1936) from German universities and research institutes (and now Austria and Italy too), and in the restriction of higher education to students having the "proper" political and racial qualifications.
>
> American scientists, trained in a tradition of intellectual freedom, hold fast to their conviction, that, in the words of the resolution adopted by the American Association for the Advancement of Science, "Science is wholly independent of national boundaries and races and creeds and can flourish only when there is peace and intellectual freedom." If science, to quote the A.A.A.S. resolution again, is to continue to advance and spread more abundantly its benefits to all mankind—and who can attack that goal?—then the man of science has a moral obligation to fulfill. He must educate the people against the acceptance of all false and unscientific doctrines which appear before them in the guise of science, regardless of their origin. Only in that way can he insure those conditions of peace and freedom which are essential for him and for the progress of all mankind.
>
> It is in this light that we publicly condemn the Fascist position towards science. The racial theories which they advocate have been demolished time and again. We need only point to the work of Heinrich Hertz in physics, Fritz Haber and Richard Willstätter in chemistry, Ludwig Traube, Paul Ehrlich and August Wassermann in biology and medicine, all German Jews and all empirical scientists. The charge that theory leads to a crippling of experimental research is tantamount to a denial of the whole history of modern physics. From Copernicus and Kepler on, all the great figures in Western science have insisted, in deed or in word, upon the futility of experimental research divorced from theory.
>
> We firmly believe that in the present historical epoch democracy alone can preserve intellectual freedom. Any attack upon freedom of thought in one sphere, even as non-political a sphere as theoretical physics, is in effect an attack on democracy itself. When men like James Franck, Albert Einstein or Thomas Mann may no longer continue their work, whether the reason is race, creed or belief, all mankind suffers the loss. They must be defended in their right to speak the truth as they understand it. If we American scientists wish to avoid a similar fate, if we wish to see the world continue to progress and prosper, we must bend our efforts to that end now.

THE ASSOCIATION OF SCIENTIFIC WORKERS

The resolution of the American Association for the Advancement of Science (Science, February 4, 1938) and recent actions of the British Association bear witness to a widespread interest on the part of scientific workers in the increasingly critical development of social problems. Members of the staff of Harvard University, the Massachusetts Institute of Technology and other institutions in Boston and Cambridge, Mass., have formed an Association of Scientific Workers, having as its aims: (1) to bring scientific workers together to promote an understanding of the relationship between science and social problems, (2) to organize and express their opinions on the steps to be taken towards the solution of these problems, (3) to promote all possible action on the conclusions reached.

The contribution of scientific workers to world progress is to-day larger than ever before. Nevertheless, they are faced with economic and international developments which continually become more critical. As a group they have virtually no control over the applications of science, and are without the means of expressing their opinions as to how these developments should be met. The only expressions of opinion which reach the public are those of a few individuals whose views are not necessarily representative and in some instances grossly misleading.

The methods and purposes of the association are stated as follows:

(1) *To bring scientific workers together to promote an understanding of the relationship between science and social problems.*

(2) To organize and express their opinions on the steps to be taken towards the solution of these problems.

(3) To promote all possible action on these conclusions.

These aims may be brought about:

(1) By holding meetings at which speakers will present various social problems and the attitude of scientists toward them.

(2) By organizing informal study groups to examine some of these problems more closely.

(3) By giving expression to the collective opinions of scientific workers, and by taking appropriate action either individually, jointly or through collaboration with existing organizations.

The association will conduct its first open meeting in Emerson Hall, Harvard University, on December 19, when President K. T. Compton, of the Massachusetts Institute of Technology, will speak on "The Social Implications of Science." The association is also sponsoring an informal discussion group on the state of science under various régimes. It is hoped soon to affiliate with other similar groups in Philadelphia and elsewhere. Communications should be addressed to the Secretary of the Association of Scientific Workers, Harvard Biological Laboratories, Cambridge, Mass.

THE ANNUAL MEETING OF THE UNION OF AMERICAN BIOLOGICAL SOCIETIES

THE annual meeting of the Council of the Union of American Biological Societies will be held on Wednesday afternoon, December 28, at 4:00 P. M., in the Salon of the Jefferson Hotel, Richmond, Virginia.

During the past year the union has continued to support projects of broad interest as promotion of *Biological Abstracts* and the teaching of biological sciences. Beginning with volume 13 (1939) *Biological Abstracts* will abandon the emergency subsidy plan which enabled it to maintain publication during 1938. The new plan adopted by the Board of Trustees provides for the usual monthly issue, but in addition this issue will be broken up into five sections as announced earlier,[1] which sell for $4–$9 a section together with a complete index. Other details of the plans for 1939 will be discussed at this time.

The Union's Committee on Biological Science Teaching is under the chairmanship of Dr. Oscar Riddle and includes the following members: E. V. Cowdry, F. L. Fitzpatrick, H. B. Glass and B. C. Gruenberg. It has undertaken two projects, one of which is already well advanced and is worthy of record here. This project is concerned with the formation of a national association for that group of more than 20,000 who teach biological subjects in secondary schools, and to the establishment of a journal to serve their special needs. Following meetings of the National Education Association in New York City on July 1, 1938, a National Association of Biology Teachers was formally established at a meeting called and largely financed by the committee. Fifteen delegates selected by members in twelve states took part in this organization meeting and elected officers. The first issue of the association's new journal, *The American Biology Teacher,* appeared in October, 1938. The committee continues its efforts to form local (city, regional or state) units of this national association, and thus to extend the association membership to teachers in all the forty-eight states and to a majority of all teachers of secondary biology. The present membership of approximately 1,500 comes largely from fifteen states, though forty states are represented. During much of 1938 Professor D. F. Miller, of the Ohio State University, has served as committee representative in the active promotion of this work. A grant of funds ($10,000 during 3 years) from the Carnegie Foundation for the Advancement of Teaching provides necessary and substantial support for work undertaken by this committee.

The promotion of *Biological Abstracts* and the integration of teachers of biology in a national association are activities which are obviously of interest to all member societies of the union. All living things age, and consequently the phenomena of aging are likewise basic. In 1937 the union secured the cooperation of the National Research Council and with the aid of a generous grant from the Josiah Macy, Jr., Foundation arranged a conference on the biological and medical aspects of aging at Woods Hole on June 25 and 26. The constructive exchange of ideas between the biologists and medical men who attended this conference was of assistance in the preparation of a comprehensive report on aging financed by the Macy Foundation, which will be published about January 1.

Privately endowed and operated biological institutions are at an increasing disadvantage compared with city, state and federal organizations. It has been suggested that a very important problem for the union it to formulate ways and means whereby the Federal Government may come to their support.

The union is eager to serve the member societies in any matters which are of interest to them collectively or individually. Consequently the secretary of the union will welcome suggestions from individuals as well as from officers of its member societies as to matters which could profitably be discussed at the next meeting which, as heretofore, will be open to all interested persons, even though they may not be official representatives of the member societies. It is hoped that all member societies will be represented by official delegates.

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[1] SCIENCE, 88: 294, 1938.

George W. Hunter, III,
Secretary

GEOPHYSICS AS APPLIED TO CONTINENTAL STRUCTURE

On December 27, at the meetings of the American Association for the Advancement of Science, a symposium on "The Importance of Geophysics to the Study of Continental Borders" will be presented by the American Geophysical Union before the astronomers of Section D and the geologists and geographers of Section E—this symposium having been arranged by the A. G. U. Special Committee on the Geophysical and Geological Study of Continents at the request of Section E. The purpose of this symposium will be both to define the functional relationship of geology and of geophysics in the determination of structural and dynamic conditions within the invisible portions of the earth's crust; and to illustrate how enormously the opportunities for the advancement of structural geology have been increased by geophysical research methods and appliances now existing.

Chester R. Longwell, of Yale University, will introduce the series of papers in a discussion of the relative roles of geology and geophysics in modern studies of the earth's crustal structure. Lieutenant Paul A. Smith, of the U. S. Coast and Geodetic Survey, will describe the nature and precision of the sounding methods, whereby submarine canyons have been traced along a part of the Atlantic margin of North America by Dr. A. C. Veatch and himself, under a project grant from the Geological Society of America. The geologic fate of the old continent or subcontinent of Appalachia will next be discussed by Wilbur A. Nelson, of the University of Virginia, after which Maurice Ewing, of Lehigh University, will describe the methods whereby the ocean-ward slope and depth of submergence of this old land area are being discovered. The delineation of deep-seated structural features of the earth's crust in continental border belts will then be the topic of papers by C. H. Swick, of the Coast and Geodetic Survey; G. P. Woollard, of Princeton, N. J.; and Perry Byerly, of the University of California. Mr. Swick will mention the modern methods used for gravity measurements, and will describe the recent programs of gravity observation in which the Coast and Geodetic Survey has been collaborating. Dr. Woollard will describe how geologic analyses of this evidence have shown that the visible structural features of the Appalachian Mountains are paralleled by invisible (but equally great) linear structural features, deep within the crust underlying the Piedmont and Atlantic Coastal Plain regions. And Dr. Byerly will show how seismic information can be used to determine the nature and dynamic condition of some of these deep-seated structural features of coastal areas. H. T. Stetson, of the Massachusetts Institute of Technology, will next discuss how the roles of extra-terrestrial forces in inducing crustal deformation may be tested, and how certain structural problems may possibly be solved by collaborative, astronomic-geophysical-geological studies, involving the use of the crystal chronometer and of other devices for the exact determination of time and of geodetic position. W. T. Thom; Jr., of Princeton University, will conclude the symposium by summarizing the results thus far achieved through geophysical research, as well as the opportunity (and need) for further collaborative study of continental borders—which are the thresholds to the "great unknowns" of the sub-oceanic lithosphere. A discussion period will follow the last paper.

The symposium, which will begin at 2 P.M. in the Mosque, will be preceded by a morning program on the "Geology of the Coastal Plain and Continental Shelf." The twenty-four contributors taking part in these two sessions will give a searching and comprehensive review of problems which are currently under active investigation along the eastern seaboard.

H. A. Meyerhoff, *Secretary, Section E*
H. T. Stetson, *Secretary, Section D*
J. A. Fleming, *Secretary, American Geophysical Union*

RECENT DEATHS AND MEMORIALS

Dr. Charles E. Munroe, emeritus professor of chemistry at the George Washington University, died on December 7 at the age of eighty-nine years.

Dr. James Pierpont, since 1898 until his retirement with the title emeritus in 1933 Erastus L. De Forest professor of mathematics at Yale University, died on December 9 at the age of seventy-two years.

Dr. Daniel L. Wallace, from 1920 to 1931 professor of chemistry at the University of Pennsylvania, with which he had been associated for fifty-one years, died on December 5 at the age of seventy-eight years.

Ellen Louisa Burrell, head of the department of pure mathematics at Wellesley College, who retired in 1916, died on December 8 at the age of eighty-eight years.

Dr. Herbert U. Williams, who retired in 1915 as dean of the Medical School of the University of Buffalo, died on December 8 at the age of seventy-two years. Dr. Williams was appointed professor of pathology and bacteriology at the Medical School in 1894 and was a member of the faculty for forty years, retiring in 1934.

DR. JOHN DOUGLAS, clinical professor of surgery at New York University, consulting surgeon, died on December 5 in his sixty-fourth year.

DR. PORTER W. SHIMER, consulting chemist, president of the Shimer Chemical Company, died on December 6 at the age of eighty-one years.

THE division of botany of the University of California at Davis held on November 30 a special seminar commemorating the one hundredth anniversary of Schleiden and Schwann's formulation of their cell theory. Dr. T. I. Storer briefly reviewed their work and the investigations of other men which led up to the cellular concept. The importance of the cell theory in present-day studies of bacteriology, physiology, genetics and plant pathology was discussed by Drs. C. S. Mudge, Max Kleiber, F. N. Briggs and W. B. Hewitt. The publications of many pioneer cytologists were on exhibit. Microscopic demonstrations illustrating important discoveries and plants and animals used by various cytologists were arranged by members of the departments of botany and zoology.

SCIENTIFIC NOTES AND NEWS

THE Gold Medal of Achievement for 1938 of the Poor Richard Club of Philadelphia has been awarded to Dr. David Sarnoff, president of the Radio Corporation of America and chairman of the board of the National Broadcasting Company. The medal will be presented to Dr. Sarnoff at the annual banquet to be given on January 17, the birthday of Benjamin Franklin. The award is made annually to a person whose accomplishments "have materially helped advance American civilization and raised the standards of living of Americans."

THE Penrose Medal of the Society of Economic Geologists has been awarded to Reno H. Sales, chief geologist of the Anaconda Copper Mining Company. The presentation will be made at the annual dinner of the society to be held on February 14 at the Harvard Club, New York City.

AT the New York meeting on December 6 of the American Society of Mechanical Engineers the Holley Medal for "meritorious services in the development of the steam turbine" was presented to Francis Hodgkinson, honorary professor of mechanical engineering at Columbia University and formerly an associate of George Westinghouse. The Holley Medal previously has been awarded to the following men: 1924, Hjalmar Gotfreid Carlson; 1927, Elmer Ambrose Sperry; 1929, Baron Chuzaburo Shiba, of Japan; 1934, Irving Langmuir; 1936, Henry Ford; 1937, Frederick G. Cottrell. Lawford H. Fry, of Pittsburgh, received the Worcester Reed Warner Medal for written contributions to improved locomotive design and to the utilization of better materials in railway equipment. Alphonse I. Lipetz, of the American Locomotive Company at Schenectady, received the Melville Medal for a paper entitled "The Air Resistance of Railroad Equipment"; Wilfred E. Johnson, of Fort Wayne, received the Pi Tau Sigma Medal, and Arthur C. Stern, of New York City, received the Junior Award of the society.

DR. ELLIOTT C. CUTLER, Moseley professor of surgery at Harvard University and chief surgeon at the Peter Bent Brigham Hospital, Boston, was awarded on November 22 an honorary doctorate by the University of Strasbourg, France.

DR. CARL J. WIGGERS was honored by his associates at a surprise tea on the afternoon of November 23 to celebrate the twentieth anniversary of his appointment as professor of physiology at Western Reserve University School of Medicine. On this occasion Dr. Wiggers was presented with a book of photographs and letters of appreciation from the president of the university, the dean of the School of Medicine, members and former members of the staff of the department of physiology and students who had worked under him.

DR. J. EDMUND WOODMAN, professor emeritus of geology in the New York University College of Engineering, was the guest of honor at a dinner given on December 10 by his former graduate students at the Faculty Club in recognition of his twenty-nine years of service on the faculty. Dr. Woodman was head of the department of geology from 1927 until his retirement this autumn.

THE Student Branch of the American Institute of Chemical Engineers at the Ohio State University entertained Dr. Edgar C. Bain, assistant to the vice-president in charge of research of the U. S. Steel Corporation, New York City, at a dinner meeting on November 18. The dinner was attended by seventy-five members of the student branch and officers of the Central Ohio Section of the American Society of Metals and the national secretary, W. H. Eisemann. Following the dinner, Dr. Bain made an address on the theoretical and practical problems of modern steel development from a metallurgical point of view. The new colored motion picture of steel manufacture by the U. S. Steel Corporation was exhibited.

Alexander G. Christie, professor of mechanical engineering at the Johns Hopkins University, was inducted into office as president of the American Society of Mechanical Engineers at the fifty-ninth annual meeting held in New York City. The ceremony of induction, held in the presence of the society's council, consisted in the formal transfer of the gavel by the retiring president, Dr. Harvey N. Davis, president of Stevens Institute of Technology, and a short inaugural statement by Professor Christie.

Officers of the American Pharmaceutical Association have been elected as follows: *President-elect,* Dr. A. G. DuMez, Baltimore; *First Vice-president,* F. O. Taylor, Detroit; *Second Vice-president,* F. J. Cermak, Cleveland; *Members of the Council,* H. C. Christensen, Chicago, Ill.; R. P. Fischelis, Trenton; Ernest Little, Newark. These officers will be installed at the next annual meeting of the association, which will be held in Atlanta, Ga., the time to be announced later.

Dr. Clyde L. Cummer, assistant clinical professor of dermatology and syphilology at the School of Medicine of Western Reserve University, was reelected director and treasurer at the St. Louis meeting of the American Academy of Dermatology and Syphilology.

The title of professor emeritus of chemistry has been conferred by the University of London on Dr. Samuel Smiles on his retirement from the Daniell chair of chemistry at King's College.

Dr. Tiffeneau, professor of pharmacology and materia medica, has been elected dean of the Faculty of Medicine of the University of Paris.

Dr. D. R. Porter, associate professor of truck crops at the College of Agriculture at Davis of the University of California, will conduct research for the Campbell Soup Company with headquarters in New Jersey. He will be concerned with vegetable breeding for quality and disease resistance.

William B. Coleman, consulting chemist and metallurgist of Philadelphia, has been appointed a member of the membership committee of the Franklin Institute.

Dr. John Wendell Bailey, professor of biology at the University of Richmond, Va., is on leave for the current academic year. He is serving as director of biological research for the Chesapeake Corporation, manufacturers of kraft paper, at West Point, Va. Dr. Carl W. Hagquist, of Brown University, is teaching Professor Bailey's classes in zoology.

Dr. Arthur B. Cleaves has been granted leave of absence from the Pennsylvania Topographic and Geologic Survey to accept an appointment as geologist for the Pennsylvania Turnpike Commission, which is engaged in building the new "super highway" across southwestern Pennsylvania.

Dr. Philip A. Munz, professor of botany at Pomona College at Claremont, Calif., sailed on December 2 from New Orleans to spend several months studying the evening primrose in South America.

At the annual meeting of the trustees of the Josiah Macy, Jr., Foundation, held on December 6, two new members of the board were elected: Dr. Stanhope Bayne-Jones, dean of the Yale School of Medicine, and Dr. Charles Sidney Burwell, dean of the Harvard Medical School. Other members of the board are: Robert E. Allen, Dr. John Dewey, Dr. Harry Emerson Fosdick, William W. Hoppin, Dr. Ludwig Kast, Dave Hennen Morris, Lawrence Morris, Dr. Willard C. Rappleye, Dean Sage, Paul H. Smart, Edwin S. S. Sunderland, Dr. Samuel Trexler and J. Macy Willets. The following officers were reelected: The Hon. Dave Hennen Morris, *chairman;* Dr. Ludwig Kast, *president;* J. Macy Willets, *secretary;* Robert E. Allen, *treasurer.* Lawrence K. Frank, formerly assistant to the president, was appointed vice-president. At this meeting it was announced that Mrs. Walter G. Ladd, who established the foundation in 1930 in memory of her father, had made a substantial gift in further support of the work of the foundation. During the present year the foundation has made grants aggregating $175,420 to thirty institutions in the United States and in Europe, in support of medical research.

An Empire Rheumatism Council Research Foundation, to work in cooperation with the Admiralty to investigate the causes and the best means of prevention and treatment of rheumatic disease in the training establishments of the Royal Navy, has been established in Great Britain. The Research Advisory Committee has appointed a special *ad hoc* subcommittee, consisting of Lord Horder, Sir William Willcox, Professor Geoffrey Hadfield, Dr. Mervyn Gordon and Dr. W. S. C. Copeman, to supervise the work generally. Dr. C. A. Green, of the department of bacteriology of the University of Edinburgh, will take direct charge of the foundation. The Sir Halley Stewart Trust has granted him a research fellowship for three years for this task. He will be assisted by other permanent workers as and when found necessary. Every factor in the problem—bacteriological, biochemical and environmental—will be investigated at the chief naval training establishments.

Dr. Reginald A. Daly, Sturgis-Hooper professor of geology at Harvard University, lectured in the department of geology at the Ohio State University on the afternoons of December 1 and 2 and before the Society of Sigma Xi at the Ohio State University on the evening of December 1. The subjects of the lectures were "New Facts in Physical Geology," "The Problem of Isostasy" and "Deep-sea Canyons."

DR. SAM F. TRELEASE, professor of botany at Columbia University, gave an address entitled "Selenium Poisoning on the Great Plains" on December 14 at the university before the Kappa chapter of Sigma Xi.

DR. SAMUEL H. WILLIAMS, professor of biology at the University of Pittsburgh, will deliver the annual lecture of the chapter of Sigma Xi of the University of Maryland on January 11. Dr. Williams, who spent the summer in Haiti, will speak on "Some Aspects of Tropical Research."

PROFESSOR F. LONDON, of Duke University, lectured at an open meeting of the Purdue University Chapter of Sigma Pi Sigma, the physics honorary society, on November 28, on "The State of Liquid Helium near Absolute Zero."

DR. WILLIAM BOYD, professor of pathology and bacteriology in the University of Toronto, gave a Mayo Foundation lecture on December 1 at the Mayo Institute. His subject was "Some Reasons for the Recent Increase in Bronchial Carcinoma."

THE twenty-third Guthrie Lecture was given before the British Physical Society by Dr. A. V. Hill, Foulerton research professor of the Royal Society, on November 11 at the Imperial College, London. The subject of the lecture was "The Transformations of Energy and the Mechanical Work of Muscles."

DR. J. B. S. HALDANE, professor of genetics at University College, London, delivered the Lloyd Roberts Lecture on "Some Problems of Human Congenital Disease" at the Royal College of Physicians of London on November 17.

A NEW hall for the exhibition of Dinosaurs was opened at the Academy of Natural Sciences, Philadelphia, on November 17. It was designed and arranged by a committee of which Rodolphe M. deSchauensee was chairman. Harold T. Green supervised the technical installation and Dr. Benjamin F. Howell, curator of geology and paleontology, was scientific adviser. The opening of the hall was preceded by an illustrated lecture given by Bradford Washburn, of the Harvard School of Geographical Exploration.

THE Rose Memorial Observatory at the Nebraska Wesleyan University, which was dedicated in the spring, is a brick and concrete structure housing a six-inch equatorially-mounted refractor in the dome, with an additional room for the meridian transit instrument, clocks and chronograph. A basement room is provided, in which it is planned later to install seismographic equipment. The building is the gift of alumni and friends in honor of the late Charles Dunham Rose, who served the institution for thirty-seven years as professor of mathematics and astronomy.

AN Industrial Fellowship in Air Filter Research has been established at the Mellon Institute, Pittsburgh, Pa., by the American Air Filter Company, Inc., of Louisville, Ky. This fellowship will investigate broadly materials of value in the construction of filters for air-conditioning systems and will have the direct cooperation of specialists on the staff of the multiple industrial fellowship on air hygiene in operation in the institute. Dr. Frank F. Rupert, who has been appointed to the fellowship, has been a member of the institute since 1913 and has been associated with the fellowship in air hygiene for the past three years.

DR. E. PORTER FELT, director of the Bartlett Tree Research Laboratories, Stamford, Conn., has presented a plaque to the Massachusetts State College at Amherst, to be affixed to the present mathematics building, marking that building as the original home of economic entomology at the college.

THE first number of the *Science Observer,* a new publication addressed primarily to the school children of the nation, has been issued. The publication is part of the program of junior activities of the American Institute of the City of New York, with the aim of encouraging the interest of high-school students in science. Although issued as the official newspaper of the Science and Engineering Clubs sponsored by the American Institute, the *Observer* is expected to have a wide appeal among adults. The publication is an eight-page newspaper, tabloid size, containing four pages of news of science and club work and four pages of photographs.

Science Notes, published by the College of Natural Science, Yenching University, Peiping, China, states that the fourth annual report on the Ceramics Project has been published, reviewing the work carried out during the past year under the British Boxer Indemnity grant for ceramics research. The work includes studies on base exchange in clays, glaze suspensions and the experimental production of ceramic ware on a semi-commercial scale. This project is under the direction of Dr. E. O. Wilson. The report is issued in both English and Chinese. A chemical study of methods of composting as applied to the raw materials available in North China, subsidized by the Rockefeller Foundation, is entering upon its third year. The work with experimental stacks at Cheeloo University was suspended last year, but arrangements are now being made to continue it. The chemical work is under the direction of Dr. S. D. Wilson and the biological and parasitological phases are being conducted by Dr. G. F. Winfield, of Cheeloo University.

At the University of Oxford a statute has been promulgated amending the provisions of the statutes governing the study of forestry. The object of the proposed statute is to simplify and to render more coherent the organization of the study of forestry by merging the School of Forestry and the Imperial Forestry Institute under a single control, and thereby to enable the university to make a more valuable contribution to forestry work throughout the empire. Under the new statute the department of forestry will be under the direction of the professor of forestry, and one central committee will provide for the instruction and supervision of four classes of students. These will be (*a*) forest service probationers; (*b*) forest officers taking refresher courses; (*c*) undergraduates who have taken honors in honor moderations in natural science and graduates or undergraduates who have taken honors in a final honor school; and (*d*) candidates working for the diploma in forestry. This same committee will also provide for the higher training of forest officers and for the conduct of research into the formation, tending and protection of forests.

The boundary of Hawaii National Park, Hawaii, has been authorized to be extended eighty-six square miles, as the result of an act at the last session of Congress. Besides authorizing the addition of lands in the so-called Kalapana and Footprint area to the park, the act also authorizes the acquisition of additional lands adjacent or contiguous to the existing park for the purpose of rounding out its boundaries. The act permits the United States to accept title by donation or gift, but prohibits the expenditure of Federal money for the purchase of land. Included in the 86 square miles of land authorized to be made part of the park are 12 miles of ocean shore line and areas of historic, archeological and scenic interest. Hawaii National Park was created in order to preserve the volcanic exhibit existing on the twelve islands that comprise the Hawaiian group.

DISCUSSION

WHAT IS SOIL?

Recent references to the culture of plants in sand, cinders or gravel to which solutions of nutrient salts are added as "soilless crop production" have caused confusion as to the differences between hydroponics and non-hydroponic culture. This raises the question, "What is soil?" While soil scientists are not agreed as to all the physical, chemical and biological characteristics of the earth's surface that are to be included in the term, nevertheless they and the farmers are agreed that soil is ground or foundation in and on which plants grow if water and plant food are available. This foundation is a more or less porous solid that holds water as thin films around various-sized particles. This distinguishes soil, ground or foundation from that part of the earth's surface in which water is not so held. Thus to use the term "soilless" in any connection that ignores this fundamental difference between porous solids and liquids has no justification.

To contend that when sand, cinders or gravel have been treated and all plant nutrients removed they are therefore "soilless" and that the subsequent additions of nutrients thereto still retain these materials in such state ignores basic differences of properties that must be considered in classification. One would not contend, that when the soil solution of a fertile field has become virtually depleted of available nutrients by the growing of a crop, consequently could not sustain another crop until nutrients have been restored by whatever way this may be accomplished, the nutrient-depleted field is in a "soilless" state. The presence or absence of one or all nutrients held in solution or otherwise in a porous solid does not differentiate categorically between the soil and soilless state of culture media.

The quantity of nutrients in a culture medium reflects fertility or crop-producing potentiality. However, as other conditions are essential to growth of crops, therefore fertility of any culture medium must be considered in a relative sense whenever comparison is made. The insoluble particles of soil are not involved in its fertility. This is a function of the character of the soil solution. The insoluble character of a part of the soil certainly is not a basis for defining such material as "soilless." Insoluble material is an essential part of soil.

Soil is a means of providing vegetation with nutrients and as long as they are incorporated therein are part of the soil. The elimination of available nutrients therefrom, however, does not alter the basic physical and geologic character of the earth's crust described as soil. But soils are not studied as a geophysical science. Soils have a biologic meaning. It is the relation of the earth's crust to vegetation that determines the scope of the concept implied in the term.

The basic difference beween the soil and soilless types of culture media is in the mobility of the solutions they hold and retain. In the one case the solution is held as surface film, in the other, which contains no solid particles, the liquid manifests full hydrostatic properties.

Cinders and gravel, which can not provide the properties required of soilless culture media, are large-sized particles, hence their water-holding capacity is low. The pores are of good size, hence drainage is rapid. Frequent application of nutrient solution is necessary, which is usually obtained by flooding the beds in which the plants are set. For convenience and economy the drained solution is used over and over. Basins are necessary to hold these low water-retaining materials so as to check the too rapid drainage of the frequently added nutrient solution. But the imperative need for drainage to open the pore spaces to air necessary for growth of crops in this type of culture media emphasizes the soil characteristics of the material. The removal of the excess solution completes the picture of the true characters of a soil—water held as films by solid particles, also some water held in the free state and its flow retarded by friction, with air space between the particles arising from drainage, following saturation by rain or irrigation.

Another basic difference between the soil and the soilless types of culture media is in the amounts of water and nutrients a given volume of each provides vegetation and in the consequent effect thereof in the magnitude of production. A unit volume of culture media that contains no solids provides more water and nutrients than does one in which space is occupied by solids. In these premises are found the explanations for the markedly greater productive potentiality of hydroponics, which is obviously soilless, than that of agriculture. Those who contend that if ample amounts of nutrients were supplied to a good soil the productive potentiality per unit area thereof would equal that of hydroponics have failed to provide evidence. Because hydroponics permits denser stands of vegetation than is possible with soils, therefore larger yields are obtained. For example, a basin—1/220 acre—carrying three crops at once for part of their growth periods, the stand of each denser than that of agriculture, yielded 8.6 bushels (60 pounds per bushel) of potatoes, more than 1,000 pounds of tomatoes and celery not yet matured. Another basin of the same size planted to potatoes and corn yielded 6.8 bushels of potatoes, and although the corn is not yet mature for harvest, nevertheless the indicated yield predicts production far in excess of that known to agriculture. Experimental evidence is also at hand showing that two crops of potatoes can be so grown as to be harvested together with yield markedly exceeding the above-mentioned large yield of a single crop. The second crop is planted at such a growth stage of the first crop that when the latter has passed the period of full light requirement the former enters therein. Also evidence is at hand that the two and three crops grown together as mentioned do not constitute the full productive potentiality of hydroponics in regions having long seasons of favorable climate.

Terminology of languages does not convey the same meaning and distinctions. "Soil" in English has a synonym, "dirt—something that pollutes, such as loose earth, dust, muck, manure." These, however, are materials that enrich land—that is, build soil. The absence of these in land could in a sense be construed to mean soilless. But is it becoming to the dignity of land to call dirtless soil "soilless"? In other languages, the concept of ground and foundation has not been taken away in the terminology commonly applied to the earth's crust which supports vegetation. Earth materials like sand or gravel, if used for the culture of plants, are not classed as "soilless."

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ARE THERE DIFFERENT CRITICAL OXYGEN CONCENTRATIONS FOR THE DIFFERENT PHASES OF ROOT ACTIVITY?

RECENT investigations with apple tree roots under field and greenhouse conditions have indicated that there may be different critical oxygen concentrations for different phases of root activity.

(1) *Subsistence.* Evidence from field studies now in progress indicates that apple tree roots larger than 1 mm in diameter are able to subsist in soil atmospheres containing less than 0.1 per cent. to 3.0 per cent. oxygen for considerable periods of time when the tree as a whole is in active growth. Controlled greenhouse experiments with apple seedlings[1] point to the probability that when the oxygen in the soil atmosphere is maintained at 3 per cent., the roots are at a "subsistence level" with respect to oxygen, that is, they continue to live but grow slowly if at all. At oxygen pressures below 1 per cent. they seem actually to lose weight. This "subsistence level" probably coincides with the lower critical concentration as defined by Cannon.[2]

(2) *Initiation of new roots.* Recently Tukey and Brase[3] have found that during wet years newly planted apple trees have produced larger root systems and tops when German granulated peat moss has been incorporated with the soil in the tree hole than when topsoil alone was used. During dry years there was little or no beneficial effect from the peat. Through the cour-

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[1] J. DeVilliers. Unpublished data.

[2] William Austin Cannon, *Carnegie Inst. Wash. Pub.* 368, 1925.

[3] H. B. Tukey and K. D. Brase, *N. Y. State (Geneva) Agr. Exp. Sta. Bull.* 682, 1938.

tesy of Dr. H. B. Tukey, analyses of soil gases in boxes containing newly planted apple trees, kept under controlled conditions, were made by the authors at the Geneva Agricultural Experiment Station, and present a possible explanation of this situation—namely, that a high oxygen level may be necessary for initiation of new roots from an existing root system. In this case, a soil atmosphere containing about 12 per cent. oxygen appeared to reduce the size of the root systems and tops considerably.

(3) *Growth of existing root tips.* Normal growth of existing root tips occurs at the upper critical concentration of oxygen, as defined by Cannon. The greenhouse study with apple seedlings indicates that normal growth does not occur at oxygen concentrations below 10 per cent., even though there may be considerable growth at percentages between 5 per cent. and 10 per cent.

(4) *Absorption and accumulation.* The experiments of Hoagland and Broyer[4] have emphasized the dependence of the processes resulting in absorption and accumulation on aeration. In this connection it is noted that the ash content (as percentage dry weight) of apple seedlings grown at different oxygen pressures decreased uniformly as the oxygen percentage was decreased below 15 per cent. Since the dry weight of the root tissue was less at oxygen percentages below 10 per cent., it is probable that absorption and accumulation were inhibited at oxygen pressures below 10 per cent. This happens to coincide with the apparent upper critical concentration and may mean that maximum accumulation occurs at the upper critical concentration of oxygen.

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A PECULIARITY OF PIGMENTATION OF THE UPPER ARM OF NEGROES

DURING the routine examination of Negroes in the Johns Hopkins Hospital, Baltimore, Maryland, we have recently observed a peculiarity of pigmentation common to a significant proportion of the patients. At a point on the antero-lateral surface of the upper arm the darker color of the outer aspect of the extremity abuts on the less heavily pigmented flexor surface. In the subjects referred to, this change is not a gradual fading of the dark pigment as the eye passes medianward over the flexor surface, but the transition is an abrupt one, producing a very definite linear appearance. Usually this margin between the darker dorso-lateral and the lighter antero-median surfaces begins to be obvious a little below the greater tubercle of the humerus and follows the lateral edge of the belly of the biceps muscle distally, disappearing again just below the middle of the humerus; it averages about ten centimeters in length. The line tends to parallel and superimpose itself over the course of the cephalic vein; however, it bears no constant relation to this vessel, its course lying lateral to that of the vein in one subject and medial to it in another. The mark is usually bilateral and more or less symmetrical in the two arms, but is occasionally present on one arm and absent on the other.

A total of two hundred Negroes of both sexes, aged eleven to seventy-four years, in the hospital wards for adult patients, were examined for the presence of the line. It was sharp and distinct bilaterally in thirty-five patients, or 17.5 per cent.; in another 2 per cent., it was present unilaterally. The incidence was the same in both sexes and at all ages. The occurrence of the line was relatively as frequent in light-skinned as in dark-skinned Negroes; it has been seen in young children. In emaciated subjects with relaxation of the skin the line was usually more striking than in well-nourished patients; this was to be expected. In a colored male Jamaican the line was particularly marked and could be followed upward to the point of the shoulder bilaterally, higher than usual. This latter subject volunteered that his father had the same mark. However, there were encountered no other patients who had noted the phenomenon in relatives; the very few who had been aware of its presence on their own persons stated that it had been there as long as they could remember. Biopsy of the skin of one Negro was taken across the line; microscopically there could be observed no variation between the two sides of the line either in morphology or in the amount of pigment in the epidermis. No similar line has been encountered on the inner side of the arm, the trunk or the lower extremities of a Negro or anywhere on the body of a white subject.

Probably this observation has been made before, but we have been unable to find any reference to it. Texts such as Cockayne's "Inherited Abnormalities of the Skin and Its Appendages"[1] one would not expect to discuss apparently so common and insignificant a variation as the one under consideration. Dr. Adolf Schultz, of the Department of Anatomy of the Johns Hopkins Medical School, when consulted on the subject, stated that it is a well-known anthropological tenet that in general the dorsal and extensor surfaces of the body are somewhat more heavily pigmented than the ventral and flexor areas. It is the abruptness of this transition in the upper extremities of some Negroes which we wish to emphasize in this note.

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[4] D. R. Hoagland and T. C. Broyer, *Plant Phys.*, 11: 471–507, 1936.

[1] E. A. Cockayne, "Inherited Abnormalities of the Skin and Its Appendages." London, Oxford University Press, 1933.

PALMER HOWARD FUTCHER

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ADDITIONAL RECORDS OF HIPPOBOSCIDAE FROM MOURNING DOVES

COATNEY[1] has reported on two species of Hippoboscidae from the Eastern mourning dove (*Zenaidura macroura carolinensis*). These are *Stilbometopa podopostyla* Speiser and *Ornithoica confluenta* Say.

The writer has taken an additional species, *Microlynchia pusilla* (Speiser), in southwestern Texas. From September 2 to September 12, 1936, two or three dozen doves were killed in Bexar County in the vicinity of San Antonio. Almost without exception each bird was infested with this hippoboscid, as many as ten flies being taken from one individual. *Stilbometopa podopostyla* was taken frequently, but not so abundantly as *M. pusilla*. In a few cases both species were found on the same dove.

Determinations were made by Dr. J. Bequaert, of the Harvard University Medical School.

Microlynchia pusilla, determined by Dr. Alan Stone, of the Division of Insects Identification of the Bureau of Entomology and Plant Quarantine, also was taken from a dove near Uvalde, Texas, on October 21, 1936, by W. L. Barrett and R. W. Burgess, of this bureau.

JAMES M. BRENNAN

DIVISION OF INSECTS AFFECTING MAN
AND ANIMALS, BUREAU OF ENTOMOLOGY
AND PLANT QUARANTINE, U. S. DEPARTMENT
OF AGRICULTURE

THE TEACHING OF BOTANY IN AMERICAN COLLEGES AND UNIVERSITIES

THE Committee of the Botanical Society of America on the Teaching of Botany wishes to express its appreciation to the 264 departments of botany that have cooperated in this study. The published report summarizes the objectives, content and procedures in the teaching of the general botany courses in these departments, and adds brief discussions concerning these. It has been mailed to all cooperating departments and to all members of the Botanical Society of America. A limited number of copies of the report is available to others interested; four cents postage should accompany requests.

An additional bulletin on the construction of tests for the measurement of student achievement will be published by the end of the year.

E. L. STOVER

CHARLESTON, ILL.

SOCIETIES AND MEETINGS

THE INTERNATIONAL CONGRESS OF MATHEMATICIANS

DURING the week beginning on September 4, 1940, the International Congress of Mathematics will hold a meeting in Cambridge, Mass.

The forerunner of the International Congress of Mathematicians was a meeting held at Chicago in 1893, in connection with the World's Columbian Exposition. The officers were: W. E. Storey, president; E. H. Moore, vice-president, and H. W. Tyler, secretary. Forty-five papers were read by mathematicians from seven different countries. The principal long addresses, later published by the American Mathematical Society, were delivered by Felix Klein, imperial commissioner from Germany.

The first congress in Europe was held at Zurich in 1897. Since that time, except for the interruptions caused by the world war, sessions have been held about once every four years. The only one of these in North America was the congress of 1924 at the University of Toronto. Here hospitality on a generous scale was made possible by subventions from the Dominion of Canada and the Province of Ontario.

The most recent congress was held in Oslo in 1936. At that meeting the invitation of the American Mathematical Society for 1940 was accepted.

The numbers in attendance have steadily increased, averaging about 600 at recent congresses. Some 250 short papers have been presented by representatives of about 40 different countries.

The dates of the forthcoming congress have been fixed as September 4 to 12, 1940. The American Mathematical Society will not hold its usual summer meeting in that year. Harvard University and the Massachusetts Institute of Technology will be the principal local hosts. Some neighboring institutions will join in the hospitality, but all the institutions of the United States and Canada are invited to consider themselves as participants. Mathematicians so desiring will be housed in the Harvard University dormitories at modest rates, and meals will be served at cost in the university dining rooms. There will be accommodations for members of families, with special provision for the care of children. Those visitors who prefer hotel accommodations can be comfortably provided for in Cambridge or Boston. The society will be able to provide room and board without charge to a considerable number of foreign guests during the week of the congress. In connection with the Harvard Tercentenary in 1936 the American Mathematical Society and the Mathematical Association of America held a highly successful meeting in Cambridge, attended by some eight hundred persons, and there is every reason to expect equally satisfactory arrangements for the 1940 congress.

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[1] Coatney, SCIENCE, n.s., 88: 2281, 258, 1938.

Following precedent, there will be a score of invited addresses, each of an hour's length, and sectional meetings for the presentation of short papers.

An innovation will be four conferences, something after the pattern of recent international gatherings in Moscow for topology and in Zurich for probability. There will be a conference on algebra, with Professor A. A. Albert as chairman, one on probability, the theory of measure and allied topics, with Professor Norbert Wiener as chairman, one on topology, with Professor Solomon Lefschetz as chairman and one on mathematical logic, with Professor H. B. Curry as chairman. These conferences will give an opportunity for specialists to exchange information and opinion among themselves, and also to disseminate new and important results to the mathematical public at large. The program will include formal lectures and informal open discussion.

The short papers will be presented in six sections:

I. Algebra and Number Theory.
II. Analysis.
III. Geometry and Topology.
IV. Probability, Statistics, Actuarial Science, Economics.
V. Mathematical Physics and Applied Mathematics.
VI. Mathematical Logic and Philosophy.

A session on history and didactics will be held in connection with the congress, with the cooperation of the Mathematical Society of America.

The short papers will preferably be in one of the official languages of the congress: English, French, German or Italian, and in general will not exceed ten minutes in length.

Among the entertainment features provided will be a reception, a garden party, a symphony concert and a banquet. Several excursions will be planned, and it is hoped that many American mathematicians who have automobiles with them will cooperate with the entertainment committee in arranging additional trips for the foreign visitors to be made out of Cambridge.

Effort will be made to facilitate the travel at reasonable cost of foreigners while they are in the United States. Previous to the congress, opportunity will be given to foreigners to see New York City under the guidance of some mathematician. The New York World's Fair will probably still be in progress at that time. Excursions to Washington, Niagara Falls and other places will be arranged if there is demand.

Besides the support from Harvard University, the Massachusetts Institute of Technology and other institutions in the neighborhood, generous subventions have been subscribed for by the Carnegie Corporation, the Institute for Advanced Study, the National Research Council and the Rockefeller Foundation.

All persons, whether they expect to be present in person or not, may register for the congress. The fee for regular members is $10.00. These will receive the Proceedings of the congress. Members of families and others not participating in the scientific activities may become associate members, for which the fee is $5.00. Detailed information will be sent in due time to all members of the American Mathematical Society, as well as to all interested persons who file their names in the office of the American Mathematical Society at 531 West 116th Street, New York City.

REPORTS

GRANTS FOR RESEARCH OF THE AMERICAN PHILOSOPHICAL SOCIETY

GRANTS AWARDED FROM THE PENROSE FUND

April, 1938[1]

Frank T. Gucker, Jr., Northwestern University, for technical assistance in determining the heat capacities and heats of dilution of solutions of the simpler amino acids and their uncharged isomers	$ 650
Kenneth N. McKee, New York University, for travel and other expenses in connection with the study of the French theater during the Revolutionary period	600
William J. Robinson, New York Botanical Garden, for the study of the condition necessary for the unlimited growth of excised tissues of higher plants, primarily excised root tips	1,500
E. J. Workman and R. E. Holzer, University of New Mexico, to make electrical measurements of the surface field under thunder clouds and charge distributions within the clouds for the purpose of studying quantities of electricity involved in lightning discharges	750

June, 1938

Biological Abstracts, Supplementary support for the publication of abstracts from biological journals of the world	5,000
Edward Girden, Brooklyn College, for supplies in connection with studies on cerebral mechanisms and hearing—localization of the cortical determinants for specific auditory frequencies tested by the L-R discrimination. (2nd grant)	400
Arthur L. Hughes, Washington University, for assistance and apparatus in the study of (a) the distribution of velocities among atomic electrons and (b) conductivity and, in particular, the photoconductivity of insulating liquids and solids	650
Mary R. Haas, Eufaula, Oklahoma, for travel and necessary expenses in making a special field investigation of the history and development of the extant towns which formerly comprised the powerful Creek Confederacy. New information concerning their recent history is to be obtained through a study of the consequences wrought by historic catastrophies (*e.g.*, the Civil War) in which they as well as their white neighbors shared. New information concerning their earlier history to be obtained through a study of the dialectic variations exhibited by the different towns, since the conservatism of language retains evidence of earlier historical connections long after they have passed from memory	1,250

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[1] Other grants made in April were announced previously.

William Steel Creighton, College of the City of New York, for the completion of a handbook of North American ants begun in collaboration with the late Dr. W. M. Wheeler	700
William C. Stadie, University of Pennsylvania, for technical assistance in connection with the study of chemical action of insulin upon the intermediary metabolism of isolated, surviving tissue of normal and pathological animals	1,500
William Henry Brown, Johns Hopkins University, for technical assistance in the study of the phylogenetic classification of flowering plants	2,000
Ronald L. Ives, Science Service, for expenses in collecting evidence of glaciation, etc., from reservoir sites of Colorado-Big Thompson Diversion project before they are submerged by water and used as fill in dams, etc.	180
Christianna Smith, Mt. Holyoke College, for technical assistance in (a) the study of age involution of the thymus gland and the analysis of the factors behind the formation of Hassall's corpuscles and (b) the fetal liver during its hematopoietic stage in tissue culture	600
Ludvig Gustav Browman, Montana State University, for equipment for the study of oestrous and activity rhythms, and reproductive behavior of rats born and kept in constant darkness as contrasted with those kept in constant light	260
Josiah Cox Russell, University of North Carolina, for travel and other expenses in connection with studies in the history of the population of Medieval England	1,500
R. T. Hill, Indiana University School of Medicine, for technical assistance and supplies in an investigation of the androgenic function of ovaries	1,000
Carl C. Lindegren, University of Southern California, for technical assistance in the analysis of the mechanism of crossing-over by growing to maturity the plants produced from the spores of *Neurospora crassa.* (2nd grant)	500
Martin Kilpatrick, University of Pennsylvania, for research assistant and materials for the determination of relative acid strengths in aqueous and non-aqueous solutions	1,000
Frank E. E. Germann, University of Colorado, for technical assistance and supplies in the study of anomalous double refraction observed by Germann and Metz of solutions of certain inorganic salts in water to determine whether the effect is due to ions or to molecules formed by hydrolysis	2,000
Jean Broadhurst, Columbia University, for technical assistance and apparatus in the development of a virus test for scarlet fever susceptibility and immunity	1,750
C. L. Turner, Northwestern University, for field work in Mexico on the study of viviparity in teleost fishes; evolution of structures associated with viviparity in the family of Goodeidae, a group of fishes confined to the Mexican Plateau and adjacent regions	250
Horace G. Richards, New Jersey State Museum, for travel expenses in connection with the collection of land and fresh-water mollusks from the Corn Islands, Nicaragua, and adjacent mainland; study of these mollusks with particular attention to their bearing on problems of paleography. (3rd grant)	250
S. C. Brooks, University of California, for assistance in the study of the penetration of alkali and alkaline-earth metal ions and halides as a function of time and concentration, and metabolism of the protoplasm and sap of living plant cells	200
Philadelphia Institute for Medical Research, for assistance and supplies in the continuation of studies, through succeeding generations of the role of the thymus in the rate of growth and development of the young. (4th grant)	2,000
Peter J. Rempel, University of Southern California, for field work assistance, etc., in the study *of several plant associations, namely, conifer* forest, chaparral, pinyon pine woodland and desert, on the desert side of the San Jacinto and Santa Rosa ranges, California, and in chaparral on the seaward side of the same mountains, with respect to the differences in their environmental complexes and the phytometric responses in growth occasioned by these with a view to elucidate some of the reasons for the vegetational differences	500
Donald Young Solandt, University of Toronto, for apparatus in an experimental study of the accommodation process in the excitation of irritable tissues with special reference to the excitation of single cells of such tissues	350
Nathaniel E. Griffin, Cambridge, Mass., for support of an investigation of the sources and influence of the "Historia Destructionis Troiae" of Guido de Columnis (to form Volume 2 in a 3-volume edition of this work)	500

October, 1938

Montague Francis Ashley-Montagu, Hahnemann Medical College, for travel and clerical assistance in a study of the development of interest in the comparative anatomy of the Primates as illustrated by the life and work of Edward Tyson (1650–1708)	400
Gaylord P. Harnwell, University of Pennsylvania, for the construction of a new type of β-ray spectrograph to investigate the β-ray spectra of electron-emitting and positron-emitting radio-elements	1,000
Roberts Rugh, Hunter College and Columbia University, for assistance and supplies for: (1) comparative study of the morphology and physiology of the urino-genital systems of Amphibia; (2) study of the effect of hypophysectomy on the testis of the immature and mature bullfrog; and (3) study of the susceptibility of frog gametes to x-radiation prior to and subsequent to fertilization	350
Astronomical Hollerith-Computing Bureau, Columbia University, for assistance and materials in the preparation of a punched card catalogue of the data contained in the Boss General Catalogue of 33,342 stars and of other quantities derived from these	1,200
Jacob Klein, St. John's College, Annapolis, for a close study of classical physics, its problems, principles and origins starting from the work of Galileo	1,200
J. Bennett Nolan, Reading, Pa., for clerical assistance in the preparation of an annotated edition of the diary of Henry Marchant (1741–1796)	100
Jean Piatt, University of Vermont, for assistance and apparatus in an investigation of the factors underlying the anatomical and physiological specificity which exist between any given muscle and the nerve which supplies it; the nerve-muscle specificity problem	500
Malcolm Dole, Northwestern University, for technical assistance in a study of the effect of negative ions on the glass electrode	800

Karl F. Herzfeld, Catholic University of America, for a research associate in an experimental investigation of the physical theory of the connection between molecular structure and the absorption spectrum of organic compounds. (2nd grant)	1,200
Thomas Hume Bissonnette, Trinity College, Hartford, for assistance and supplies in an investigation of sexual photoperiodicity in animals and related phenomena	1,000
Harry Richard Seiwell, Woods Hole Oceanographic Institution, for an assistant in the investigation of internal waves in the North Atlantic Ocean	1,200
T. M. Sonneborn, Johns Hopkins University, for technical assistance in the study of the genetics of Paramecium—the analysis of the mechanism of inheritance, particularly inheritance of mating type. (2nd grant)	900
Fred A. Berkley, Montana State University, for travel and supplies for a bibliographical and herbarium study in preparation of a monograph of the Anacardiaceae (Sumac family)	550
R. G. Herb, University of Wisconsin, for supplies in connection with studies in nuclear physics by means of a 2.4 million volt electrostatic generator	400
Fred E. D'Amour, University of Denver, for technical assistance and supplies in connection with the study of the endocrine control of ovulation and related physiologic changes. (2nd grant)	1,000
E. B. Babcock, University of California, for technical assistance in the cytogenetic investigations in the Cichorieae and their bearing on taxonomy, phylogeny and evolution of the higher plants	400
Eliot R. Clark, University of Pennsylvania, for technical assistance in the continuation of the study of the growth and behavior of various cells, tissues and organs as observed microscopically in the living mammal, with the aid of permanently installed transparent chambers and windows. (2nd grant)	300
Robley D. Evans, Massachusetts Institute of Technology, for technical assistance, equipment and supplies for an international interchecking program to evaluate, correlate and extend the scattered knowledge of the radioactivity of natural materials	3,000
Arthur M. Banta, Brown University, for a research assistant in the study of the effect of the characters (phenotype) of the mothers upon the characters (phenotype) of her offspring, apart from her genetic constitution (genotype)	1,200
Gregory Pincus, Clark University, for a research assistant in the study of metabolism of rabbit eggs and embryos in different inbred strains and in hybrids between them, with particular reference to the metabolic basis of size differences in early ova	1,200
Nabih Amin Faris, Princeton University, for photographic supplies and photostats for a critical and comparative study of the Arabic calligraphy based on old manuscripts, with a view to determining the development of the Arabic characters, diacritical points and vowel signs	300
Edwin R. Helwig, University of Pennsylvania, for African travel expenses in connection with the study of the phylogenetic history of the chromosome complex in the Orthoptera	350
John Edward Dinsmore, Herbarium of the American Colony, Jerusalem, Palestine, for travel and technical assistance in a study of the taxonomy of the iris in Syria and Palestine and the discovery of new species	300

GRANTS AWARDED FROM THE ELDRIDGE REEVES JOHNSON FUND

Academy of Natural Sciences of Philadelphia:

Geology and Paleontology Department, for assistance in the study of type and undescribed specimens of fossils in the academy's collection in preparation for the making of a published, annotated and illustrated list of such specimens, including new material not heretofore described or illustrated	3,580
Henry W. Fowler, for the publication of a report on the fishes obtained by the George Vanderbilt South Pacific Expedition of 1937, comprising over 25,000 specimens, new species, rare or little known forms, besides extensive items in distribution, variation, taxonomy, etc. Publication to be a number of the "Monograph" series of the academy	1,500
Samuel George Gordon, for travel expenses in making a mineralogical survey of the Atacama Desert, Chile	920
Francis W. Pennell, for travel expenses, photography, etc., in making a study of the Scrophulariaceae of Western Temperate North America on a taxonomic, geographic and phylogenetic basis	500
H. Radclyffe Roberts, for field work and transportation in making a distributional and taxonomic study of the Orthoptera of Mexico and especially their relation to the Orthopteran fauna of the United States	500

University Museum, University of Pennsylvania:

Alan Rowe, for printing and editorial work in the publication of his manuscript, "The Four Canaanite Temples of Beth Shan." This volume deals with the temples of Rameses II, Seti I and Amenophis III excavated by the Palestinian Expedition at Beth Shan	2,500
V. J. Fewkes, for printing and editorial work in the publication of his manuscript "Excavations at Homolka," a final report of the completed investigation of an aneolithic fortified camp site in Czecho-Slovakia with an occupation period of several hundred years	1,000
H. U. Hall, for printing and editorial work in the publication of his manuscript entitled "Studies of the Sherbro Tribe, Sierra Leone," a report of the expedition to Sierra Leone, West Africa, conducted during 1936–37	1,000
Frederica de Laguna and Kaj Birket-Smith, for printing and editorial work in the publication of their manuscript entitled "Ethnology of the Eyah Indians of Alaska," covering ethnological material obtained by a joint expedition of the University Museum and the Danish National Museum in 1933	1,200
J. Alden Mason and Linton Satterthwaite, Jr., for architectural and editorial work in the completion of their manuscript and architectural drawings for their report entitled "Excavations at Piedras Negras," a final publication of seven years' work at the site of the ancient Maya city of Piedras Negras, Guatemala, including architectural studies of the temples and palaces which have been uncovered by the expedition as well as studies of the artistic and historical material found at the site	1,800

Eldridge Reeves Johnson Foundation for Medical Physics, University of Pennsylvania:

Leslie A. Chambers and J. B. Bateman, for mate-

rial, equipment and technical assistance in the study of the molecular organization of cell surfaces in relation to biological activity and specificity	1,500
Detlev W. Bronk, for material, equipment and assistance in the study of the mechanism of chemical excitation of nerve cells	1,800
Detlev W. Bronk, for material, equipment and assistance in making a general investigation of the nervous control of body organs in terms of the properties of nerve cells and fibers which make up the sympathetic and para-sympathetic nervous systems; with special reference to the physico-chemical processes which occur within these systems	2,050
H. K. Hartline, for material and equipment in connection with the study of the photo-chemical and neural processes of vision	1,500

SPECIAL ARTICLES

IDENTIFICATION OF THE FILTRABLE, TRANSMISSIBLE NEUROLYTIC AGENT ISOLATED FROM TOXOPLASMA-INFECTED TISSUE AS A NEW PLEUROPNEUMONIA-LIKE MICROBE

THE isolation from Toxoplasma-infected tissues of a filtrable, transmissible agent capable of producing a characteristic nervous disease in mice was reported recently.[1] The nature and origin of this agent was perplexing because (a) it was not demonstrated in thousands of normal mice, (b) it did not appear to possess the properties necessary for natural host-to-host transmission either by itself or by means of an arthropod vector, and (c) it appeared to be intimately associated with certain strains of Toxoplasma. The morphological appearance of the minute structures observed intracellularly and extracellularly in some of the infectious material suggested a similarity (a) to "chromatin" structures within the Toxoplasma and (b) to stages described for the causative agents of pleuropneumonia and agalactia. The relationship to "chromatin" structures of Toxoplasma, admittedly a fantastic concept, was rendered even more so by the finding that they were Feulgen-positive, while the structures in the "neurolytic agent" material were Feulgen-negative. The relationship to the causative agents of pleuropneumonia and agalactia appeared unlikely at first because their minimal size of 125–150 mμ and their capacity to grow in a cell-free medium containing serum differentiated them from the neurolytic agent material which appeared to have a minimal size of 314 to 360 mμ and failed to grow in serum-containing media.

By a modification of technique, however, it has proved possible to grow the "neurolytic agent" in a cell-free medium, consisting of ordinary nutrient broth, 10 per cent. Seitz-filtered, sterile, bovine serum and 0.5 per cent. glucose. No growth was perceptible in the initial cultures, but one or two transfers of the apparently negative cultures to fresh medium invariably showed a faint opalescence which, upon dark-field examination, revealed structures not unlike those seen in "neurolytic-agent" infectious material. Successful cultures were thus obtained from each of six infectious brains—some of which had been kept in the dried state for months and others fresh—while simultaneous tests with the same medium to which no glucose was added failed in a number of instances; in the absence of serum, all attempts were negative. Subculture of the serum-glucose-broth cultures on serum-agar yielded colonies 20 to 100 μ in size, which on direct microscopic observation and study of Giemsa-stained impression films were quite similar to those described by Ledingham[2] for pleuropneumonia and agalactia. The evidence that the cultivated microorganisms are identical with the "neurolytic agent" is as follows:

(1) More than 18 subcultures have now been obtained, and the cultures continue to show in mice the same pathogenic effects (both clinical and pathological manifestations) as the animal-passage material.

(2) The active agent is filterable, although with culture material a smaller size was obtained for the minimal infectious particle (determined by animal inoculation as well as by culture), *i.e.*, 250 to 292 mμ instead of 310 to 360 mμ.[3]

(3) Its pathogenicity is inactivated at the same temperature (about 45° C. for 15 minutes).

(4) The cultivated and animal-passage materials give rise to complete immunity against each other.

Elaboration of exotoxin in vivo and in cultures: In the first report[4] it was indicated that the brain lesions produced after intraperitoneal or intrathoracic inoculation were not caused by the transmissible agent itself but rather by some non-transmissible substance formed when growth occurred in certain sites. Filtration of cultures through Seitz filters, which hold back the infective particles, yielded a material which upon intravenous injection (but not intracerebral or intraperitoneal) of 0.5 cc amounts in 3-weeks-old mice (old mice react irregularly or not at all), reproduced the typical nervous signs within 1 to 2 hours. Most of these mice died within a few hours, but the surviving ones continued with the nervous signs and exhibited the same acute necrotic lesion in the posterior pole of the cerebellum, with acidophilic necrosis of Purkinje cells, so often observed in virus affections, which has already been described.[5] Neither the brain nor the viscera of these mice contained a transmissible agent.

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[1] A. B. Sabin, SCIENCE, 88: 189, 1938.

[2] J. C. G. Ledingham, *Jour. Path. Bact.*, 37: 393, 1933.

[3] Gradocol membranes and filters were kindly supplied by Dr. J. H. Bauer.

[4] A. B. Sabin, *loc. cit.*

The toxin is produced early during growth, is present in very small amounts, and disappears from the culture within 2 days of its appearance. It is thermolabile, being inactivated at 50° C. but not at 45° C. for one-half hour. It is apparently antigenic and the same as that produced *in vivo* during infection, since recovered mice are immune to it.

Natural habitat and transmission: Previous attempts to isolate a similar agent from thousands of normal mice by animal inoculation and subinoculation failed. A new attempt was made by the technique of cultivation and subcultivation just described. The viscera and brains of ten 1-month-old mice from the normal stock were cultured separately with negative results in the initial culture tubes, but on transfer to fresh medium, a pure culture of a pleuropneumonia-like microbe was obtained from the brain but not from the viscera (liver, spleen, lung) of one of the mice. This strain has been repeatedly subcultured since, and still requires serum although not the added glucose for its growth. It is not, however, pathogenic for mice, several passages in mice have not yet made it so, and no toxin has been found in its cultures. Since the cultivated as well as the animal-passage material does not appear to be capable of multiplication in the peripheral sites which permit of direct host-to-host transmission by means of an arthropod vector, it is necessary to consider the possibility of a new type of vector for these microorganisms, namely, bacterial or perhaps even protozoal. Klieneberger[6] has already shown the existence of a pleuropneumonia-like microorganism in natural symbiosis with a streptobacillus and has also experimentally induced a symbiosis with *B. tetani* and *B. tetanomorphus*. The intimate association of the present pleuropneumonia-like microbe with Toxoplasma may perhaps be another form of symbiosis resulting from a chance encounter in normal mice, maintained by repeated passage with a consequent development of the special pathogenic properties in what might originally have been a non-pathogenic pleuropneumonia-like microorganism. I have been informed by Dr. G. M. Findlay that he has encountered a similar disease among mice in London in the course of routine passage of the yellow fever and lymphocytic choriomeningitis viruses and that Dr. E. Klieneberger has isolated a pleuropneumonia-like microorganism from the material. He has compared the infective agent from English mice with that of mice which I sent him and found that the two were essentially similar and immunologically identical.[7]

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[5] *Ibid.*

[6] E. Klieneberger, *Jour. Path. Bact.*, 40: 93, 1935; *Jour. Hyg.*, 38: 458, 1938.

[7] To be reported in a forthcoming issue of *Lancet*.

THE LIFE-MAINTAINING EFFECT OF CRYSTALLINE PROGESTERONE IN ADRENALECTOMIZED FERRETS[1]

IN the dog, ferret and cat the condition of pseudopregnancy prevents the appearance of adrenal insufficiency following adrenalectomy. Estrus, contrariwise, increases the need for cortical hormone therapy. Somewhat similar but less striking results occur in the rat. Thorn and Harrop found resemblances between cortical extracts and several sex hormones on electrolyte excretion of intact dogs. The chemical similarity between cortical substances and progesterone suggests that the latter might be the life-maintaining agent during pseudopregnancy, but direct tests in several laboratories have failed to demonstrate it. Furthermore, the estrogens which have an effect like progesterone and cortical hormone in intact dogs are toxic in adrenalectomized rats.[2]

With the idea that dosage or species variables may have been the cause of previous failures to maintain life, we have investigated the effect of progesterone and other sex hormones in adrenalectomized ferrets.[3]

Anestrus adrenalectomized ferrets fed a diet of fresh milk and fresh, ground, lean meat, to which is added a 2 per cent. Na-salt supplement, demand, with a good uniformity, one cc of cortical extract per day (equivalent of 30 gms fresh adrenal tissue) for maintenance. Without therapy adrenal insufficiency (loss of weight, anorexia and asthenia) occurs on the average (of 15 cases) at 6 days with a range of 3 to 10 days. During estrus the cortical hormone requirement is at least doubled.

The effect of prolonged progesterone treatment on adrenalectomized ferrets has been observed in six instances on five animals. Ovariectomized and non-ovariectomized females and one castrate male were used. With adequate dosage all signs of adrenal insufficiency were prevented for the duration of treatment, or, as occurred in three cases, when dosage was reduced to inadequate levels so that adrenal insufficiency appeared, revival to excellent health was effected by giving 5 mgm progesterone daily without any cortical hormone. Treatment was continued for 32 days in

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[1] This work was aided by a grant (to R. G.) from the Penrose Fund of the American Philosophical Society.

[2] Most references to above work are cited by R. Gaunt, *Cold Spring Harbor Symp. Quant. Biol.*, 5: 395, 1937.

[3] The authors are indebted to Dr. W. W. Swingle, of Princeton University, for the cortical extract used here and for other assistance; and to Dr. Erwin Schwenk, of the Schering Corporation, who furnished the progesterone (Proluton) and testosterone propionate (Oreton).

two cases, 30 days in one, 20 days in two and 14 days in another. Apparently life could have been maintained indefinitely with continued treatment. Dosages used varied from 0.5 to 5 mgm per day. The former was ineffective and the minimal life-maintaining dose seemed to be approximately 2 mgm per day. Marked weight gains occurred during treatment in 5 of 6 cases. The salt supplement usually added to the meat diet was not essential for the observed effects as determined by its omission in one case. All animals died of adrenal insufficiency when therapy was discontinued, showing that adrenalectomy was complete.

In two cases a commercial corpus luteum extract from hog ovaries proved toxic and reduced the life-span, perhaps because of estrin contamination.

Testosterone propionate, a substance chemically and in some ways biologically similar to progesterone, was slightly, if at all, effective in four animals, in doses of 5 or 10 mgm per day. The animals lived for 13, 12, 8 and 11 days. Similar results have been obtained in rats by others. Estrone given to two animals in doses of 0.1 and 0.2 mgm daily was toxic, as in the rat, and as was to be inferred from the effects of spontaneous estrus.

CONCLUSIONS

Crystalline progesterone will maintain adrenalectomized ferrets in excellent health and will relieve an established adrenal insufficiency. The phenomenon of life-maintenance in pseudopregnant adrenalectomized animals is therefore probably explained on the basis of progesterone secretion alone. Testosterone is nontoxic and non-beneficial to adrenalectomized ferrets, while estrone is toxic.

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NICOTINIC ACID AND THE GROWTH OF ISOLATED PEA ROOTS[1]

IN earlier publications[2,3] it has been shown that vitamin B_1 is an essential accessory factor for the growth of isolated pea roots. Pea roots were maintained for 14 weekly transfers in a medium containing only vitamin B_1 in addition to sucrose and mineral nutrients. It was also shown, however, that the growth rate of isolated pea roots decreases in successive transfers if vitamin B_1 is the only accessory growth factor. Such roots also become progressively thinner as the weekly transfers are continued. Vitamin B_1 alone is not then the only growth factor essential for the sustained growth of the isolated pea root. Other investigators have suggested that specific minor elements[4,5] or specific "essential" amino acids[6] constitute this second essential growth factor in the case of the isolated tomato root. The present authors also found that a mixture of 16 amino acids possessed activity as the second growth factor for the isolated pea roots.[7] The mixture of amino acids used in these earlier experiments was, however, a purely arbitrary one. In work which will be described in detail elsewhere, each individual amino acid was tested both alone and in combination with other amino acids (always in the presence of added vitamin B_1) for its ability to increase the growth of the isolated pea root above the level of growth rate of similar roots supplied with only vitamin B_1 as the accessory factor. In this way a mixture of amino acids having the composition shown in Table 1 and optimal for support of the growth rate of the isolated pea root was obtained. This mixture of amino acids was found capable of increasing the growth rate *of isolated pea roots over the growth rate obtained* with vitamin B_1 alone, but to be incapable of supporting growth at an undiminished rate for more than three weekly transfers. It is clear then that the second factor limiting the growth of isolated pea roots is not merely a combination of amino acids. It has also been found that the factor in question is not a specific minor element.

TABLE 1

AMINO ACID MIXTURE OPTIMAL FOR THE GROWTH OF PEA ROOTS

Amino acid	Concentration in medium in mg. per liter
Asparagine	0.1
Glycine	0.05
Glutamic Acid	0.5
Isoleucine	0.015
Leucine	0.5
Tryptophane	0.5
Valine	0.05

Nicotinic acid, in combination with vitamin B_1, exerts a very striking effect on the growth of the isolated pea root, as is demonstrated by the following experiment. Approximately 700 pea roots, which had been in culture on vitamin B_1 free medium for one week, were divided into 7 series. These separate series received as accessory growth factors either vitamin B_1, the amino acid mixture, nicotinic acid or combinations of these. The series receiving only vitamin B_1 will be *considered the control. It may be seen in Table 2 that* in all series in which nicotinic acid and vitamin B_1 were not both present there was a steady decrease of

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[1] Report of work carried out with the assistance of the Works Progress Administration, Official Project No. 665-07-3-83, Work Project W-9809.

[2] J. Bonner, SCIENCE, 85: 183-184, 1937.

[3] J. Bonner and F. T. Addicott, *Bot. Gaz.*, 99: 144-170, 1937.

[4] W. J. Robbins and M. Bartley, SCIENCE, 85: 246-247, 1937; *Bot. Gaz.*, 99: 671-728, 1938.

[5] P. R. White, *Plant Physiol.*, 13: 391-398, 1938.

[6] *Ibid.*, 12: 793-802, 1937.

[7] J. Bonner and F. T. Addicott, *loc. cit.*

TABLE 2

EFFECT OF VITAMIN B_1, NICOTINIC ACID (0.5 MG PER LITER) AND "PEA ROOT AMINO ACID MIXTURES" DONE IN COMBINATION, ON THE GROWTH OF ISOLATED PEA ROOTS

Growth factors added	Growth in mms per week, average for 2 weeks		
	II and III	IV and V	VI and VII
B_1	41.1	23.6	11.6
Amino acids	32.5	22.1	5.9
Nicotinic acid	45.8	25.0	9.2
Nicotinic and amino acids	46.3	18.4	16.2
B_1 and amino acids	47.0	30.1	20.1
B_1 and nicotinic acid	55.8	70.6	72.6
B_1, nicotinic acid and amino acids	54.2	68.6	77.7

growth rate with each weekly transfer. Nicotinic acid alone, however, supported growth of the isolated pea root at least as well as did vitamin B_1. Combination of the amino acid mixture with either nicotinic acid or with vitamin B_1 supported the growth at a somewhat higher level than did either substance in the absence of the amino acid mixture. Combination of nicotinic acid with vitamin B_1 or with vitamin B_1 and the amino acid mixture, on the other hand, resulted in a steady increase of growth rate. This increase has been found in several different experiments and is of the order of 50 per cent. above the initial level. Although the experiment recorded in Table 2 was maintained through only 7 weekly transfers, a second experiment was maintained through 10 weeks with undiminished rate of growth of the roots which received nicotinic acid in addition to vitamin B_1 and the amino acid mixture (Fig. 1). Such roots were indistinguishable in appearance (except for their greater length) from roots which had been but 2 weeks in culture.

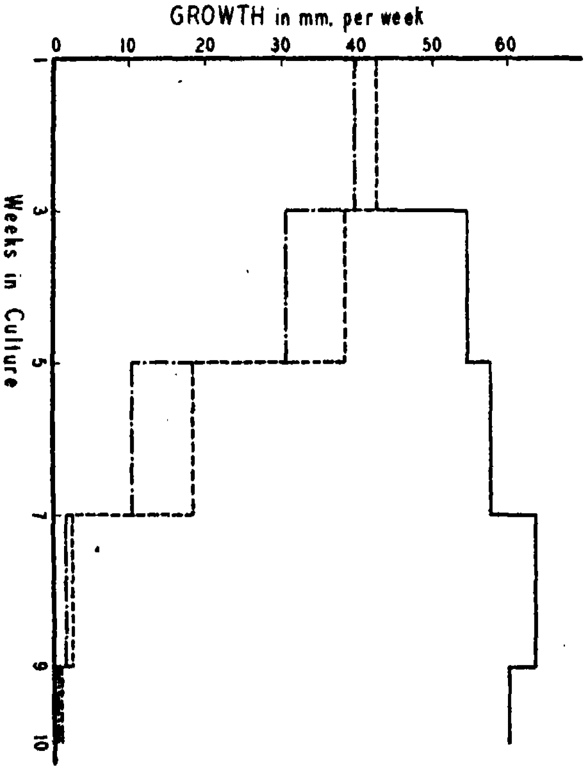

FIG. 1. Growth of isolated pea roots with and without nicotinic acid in addition to vitamin B_1 and the optimum mixture of amino acids: Solid line, nicotinic acid plus vitamin B_1 plus amino acids; dotted line, vitamin B_1 plus amino acids; dot and dash line, vitamin B_1 alone. Nicotinic acid was introduced into the medium of part of the series which had been cultured in vitamin B_1 and amino acids at the end of the third week. No accessory growth substances are added to the roots during the first week.

Although the data presented (in Table 2) do not yet permit of a definitive decision, still it seems possible that the amino acid mixture is not essential to the continued optimal growth of isolated pea roots. Nicotinic acid, however, must apparently be regarded as a factor quite as significant as vitamin B_1 in the nutrition of the isolated pea root. The promotive influence of nicotinic acid on the shoot growth of the isolated pea embryo[8] also must in all probability be attributed to the effect of this substance on the growth of the root.

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[8] J. Bonner, *Plant Physiol.*, in press.

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BINGER, WALTER D. *What Engineers Do; Engineering for Everyman.* Pp. xviii + 304. 111 figures. Norton. $2.75.

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CHAPMAN, KENNETH M. *The Pottery of Santo Domingo Pueblo; A Detailed Study of Its Decoration.* Memoirs of the Laboratory of Anthropology, Vol. I. Pp. 192. 79 plates. 34 figures. The Laboratory, Santa Fé, New Mexico. $4.00.

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ADDRESS OF THE PRESIDENT OF THE ROYAL SOCIETY[1]

By Sir WILLIAM BRAGG

DIRECTOR OF THE ROYAL INSTITUTION

According to our honored custom I preface this annual address by references to those of our fellows whom death has taken from us during the past year.

The past year has included many events which might well be mentioned in this annual address. One of them has, however, elbowed out most of the rest. The two numbers of *Notes and Records* which have begun a new enterprise contain interesting and informative accounts of our doings since last November. I believe that fellows have appreciated this social and intimate addition to the publications of the society, and that they will join with me in an expression of our gratitude to the officers who have produced it, and especially to the one who has on this, as on so many occasions, taken the lion's share of the work. The doings of the society are noted and recorded in this periodical more effectively than I could do in a presidential address.

I must now speak of an event which is surely uppermost in the minds of all who have received the nominations of council for next year. We are to lose the services of Sir Frank Smith. You may be surprised at his decision not to seek renomination when we would gladly have kept him for one more year. It happens, however, that two more of our officers must step down at the end of next year, and Sir Frank has pointed out that if three were to leave at one time the business of the society might be seriously affected. We can not, therefore, ask him to stay. We must take advantage of the opportunity thus given us to tell him how grateful we are for the work he has done for the society. His secretaryship has been distinguished by a rare exhibition of capable service. The place which the society fills in public life and its harmonious cooperation with other institutions are largely due to his wisdom and tact and his power to unite workers in a common effort. Indeed, it is impossible to think of what he has done for us, without reflecting at the same time that he has exercised his talents in a wider field, and that in the words that may seem simple but are full of meaning, he has been and is still, I am glad to say, a great public servant.

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[1] Given at the anniversary meeting on November 30, 1938. The address also contained obituary appreciations of the fellows who died during the year.

I should like to add a reference to one very interesting matter. As the result of a discussion between Dr. Krüss, head of the Prussian State Library in Berlin, and myself, when he attended the International Documentation Conference at Oxford in September last—a discussion initiated by Dr. Krüss—I have lately received a letter from Dr. Bosch, president of the Kaiser Wilhelm Gesellschaft, inviting the cooperation of the Royal Society in some scientific enterprise which would advance science and, at the same time, promote understanding and good will. Dr. Bosch asks that a few representatives from this side should be the guests of the Kaiser Wilhelm Gesellschaft for a week during this winter and hopes that we would play the part of hosts in return. During these interchanged visits, lectures would be given and consultations would be held; and it is reasonably to be hoped that some plan of a joint work would emerge. I feel sure that this gesture of friendliness will receive a warm welcome from the fellows of the society.

I will now say a few words on a subject which seems to me to exhibit a greater importance the more closely it is examined.

In recent years the very great increase in the output of the results of research has placed our scientific societies in a difficult position. There is correspondingly more to be published, and, at the same time, publication costs have increased. Consequently, the societies' finances are overstrained, and publication of worthy material is restricted. The Royal Society receives a government grant for publication purposes, far the greatest part of which is passed on to other societies. The grant is sufficient to meet only a portion of the applications for assistance that are made.

There is another reason why the increase in output presses hardly on our societies. In order that a proper standard of merit shall be maintained, it is customary to submit each paper, when it is sent in, to one or more referees. Now the number of possible referees is limited, and is even becoming relatively smaller as specialization increases. I may take this opportunity of expressing the gratitude of the society to those fellows who spend so much care on the examination of the papers submitted to them. The officers realize regretfully that they ask them for a considerable fraction of their time and energy.

Our shelves display the effects of increase. As we look at the long rows of bound periodicals in our studies, we realize not only that many years have slipped past since we began to collect them, but also that their very appearance is an item of history. A long time ago they were comparatively small and thin. But they grew: they shrank during the bad years of the war, but soon resumed their increase, and of late they have swollen until they have become unmanageable and must needs be divided. Still the papers come pouring in, and the rate of flow even increases. It is all to the good, and a healthy growth which we do not want to check; but there are practical difficulties which invite an attempt to solve them.

It seems to me that when we try to consider this matter from points of view all round it, we are driven to seek for a precise answer to the questions, "Why *do* we publish? Why do we submit papers and why does the society print them, if they are good enough?"

When a man submits a paper to the society he is, in the first place and quite rightly, anxious for the satisfaction of showing what he has done to those who will understand it. Another reason which has certainly grown in strength of recent years is that he wants to establish his reputation and position. Doubtless, he has also the wish that his work may be of service, though this desire may be relatively less obvious even to himself. To the society the opportunity for service is the principal reason; for it can not be held that the society exists in these days, only or even mainly, for the pleasure and profit of its fellows.

The existence of our society depends on our belief that knowledge is to be obtained by experiment. In that belief our founders of nearly three hundred years ago organized the rules and procedure on which we have acted ever since. Their foresight has been amply justified; but they could not have imagined how far experiment would carry their successors and others who have held the same belief. We have been led to the discovery of a natural world of vast extent; and without limits that we can see. Every part of it is of interest and every item of knowledge that we find there has a bearing on what we think and do. As we see and know, the results of the exploration have already been immense; modern life has been profoundly affected thereby. The natural knowledge which the Royal Society set out to improve has become one of the greatest influences of these times. The society and other bodies and individuals that have followed in its footsteps have, therefore, become possessed of certain most important opportunities, which are indeed duties. One of these is still, as it has always been, the encouragement of research, wisely conceived and well directed. A second is the preparation and presentment of the results of research, so that they can be sufficiently appreciated, and can be incorporated with understanding into every activity, intellectual or physical, to which they apply. We are not, as discoverers, responsible for the uses that are made of our discoveries. We ought not to claim, in my opinion, to be given the direction of affairs in which our discoveries play a great part simply on account of that fact. But we are, at least, bound to see that our acquired knowledge is rightly stated so that it can be rightly used. We may also, as scientists, feel that we ought to help in putting knowledge to good use. This duty is actually discharged by numbers of men in these times.

It is curious to think that the feeling of responsibility is of recent growth. There was even a time when a discovery could be considered a private possession, to be withheld from general knowledge if thought fit. Newton, Hooke, Cavendish and many others were often in no hurry to give to the world what they had found; they were influenced by indifference, by fear sometimes, even by impish playfulness, as when truths were hidden in anagrams. They did not then look upon natural knowledge as an inheritance belonging to mankind, which when discovered ought to be shared.

Rumford, at the end of the eighteenth century, was one of the first to accept and proclaim his responsibility, and act upon it, when he tried to apply the laws of heat to the economy of fuel. His first attempt in London was made at the Foundling Hospital. The Royal Institution, in its first form, was his attempt to give concrete expression to his idea. The founders of the British Association were urged in their work by a similar motive and were to some extent under the belief that they were repairing a defect of the Royal Society. The vigorous action of the association in these days is a most commendable extension of its original purpose. The Royal Society undertakes a special part of the general responsibility. It is concerned with affording opportunities for the publication and discussion of original discovery, it also encourages discovery by the administration of funds entrusted to it for that purpose. And, of course, it represents officially the scientific activities of the nation, acting as an adviser on such matters in public affairs. In this field it has full opportunity for the exercise of all its powers. This limitation of service does not free the society from the need to attend always to the one great purpose, more fully realized of recent years, that of opening to mankind the new fields of natural knowledge. The new fields are not merely to be penetrated, they are also to be made public. There is, of course, a well-known saying that praises knowledge because it is useless. This cryptic statement would seem to be an ethical injunction to the researcher; it certainly does not mean that the most desirable knowledge is of no use to any one but the discoverer.

Even within the range of activities to which the Royal Society confines itself, in which contact with the general public is not often made, regard must be paid to the future exposition of discovery. Because the results of research have become so voluminous and so important, the manner of stating them, of arranging and storing them has also become important. We have to bear this in mind when we think of the arrangement on our shelves.

At the present time, the volumes of our *Proceedings* and *Transactions* have a certain resemblance to a building site on which the contributors of materials have shot their goods: and it must be said that the shooting is often done without regard to convenience of subsequent handling. He who would construct for himself a whole building finds it difficult to make use of the materials provided. Any one who has completed a piece of research and hopes that it may be accepted and published by the Royal Society or any society of learning is in the first place at pains to describe what he has done, the methods he has used and the inferences that he draws from his results. The manner of telling his tale will depend on the purpose he has in mind. He may think that he ought to set out his facts in full detail, so that any reader who is interested shall at least find all that he wants. If he is on the threshold of research work, he will often be influenced by the desire to prove his knowledge and ability; and may be led to make his tale long and complicated. It is very likely that he has not before him a mental picture of the man for whom he is writing; if he has, it is probably that of an expert, who is working in the same narrow region as himself, who knows all the technical terms and is familiar with the hidden difficulties of the subject (which, therefore, must be discussed in full), and will pick holes if he can. It is true that writing of this kind is of the highest value: expert must talk to expert.

Nevertheless, such writings make dull and difficult reading for the great majority of those who are interested in scientific discovery. How few there are who can critically study a paper of a certain type is only too well known to our secretaries and the chairmen of our sectional committees who must find referees to judge its merits, and to referees themselves who accept their often laborious task. When such papers are read at a meeting of the society, the paucity of the attendance and the lack of good discussion are obvious and distressing. In fact, it has been found well to take vast numbers of such papers as read, and even then the discussion of the few that are left is often disappointing.

It is on this account that greater stress has been laid recently on the provision of opportunities for organized discussions in which some important subject of recent development is considered by the workers in that subject. The discussion ranges over a wider field than that of a single worker's account of his new discoveries. It is much more interesting and informing to the general body, as the very satisfactory attendances have shown. Clearly there is a desire to understand the main purpose and the principal achievements of each growing subject.

I believe that fellows, and others, have welcomed the recent plan of publishing summaries of papers as an appendix to the *Proceedings* as soon as the papers are received, publication of the papers themselves being deferred until approval has been given in the usual way. Not merely is an earlier announcement of discovery made on this plan, but the collection of summaries presents the general trend of research to those who are not specialists.

Summaries are the expression of a natural reaction to the difficulties caused by the growing specialization of research. They represent a certain recognition of the principle that discovery must be accompanied by exposition, the principle that has been little regarded in past years, but now demands acceptance.

The ideal summary is more than a mere digest or shortened form of the paper. It differs from the paper itself in that it is addressed to a wider circle of readers which may include the experts but contains also many others who should, in fact, receive the principal attention. For this reason it may be more difficult to write than the paper itself, because it must take into account the interests and the understandings of those who will rarely read the original paper, even if they could do so, but will gladly absorb the meaning and the information of the summary, especially if there is a connection with their own work. When the summary is written with this wider view it becomes literature, though the paper itself may be no more than a record.

Another reason for greater attention to the writing of summaries is that specialization quickly takes explorers out of sight of each other and out of sight of the main body. It is natural for them to talk to each other only and to forget every one else. Consequently, it becomes difficult to incorporate their work into any general scheme. Also it is dangerous for researchers to be so far out of reach. It is natural for them to lose a sense of proportion and to imagine, each one, that his is the main line, or at least a very important line of advance. Who is to call a halt when this happens, unless the work that is going on is so far appreciated that a general opinion can be formed as to its advisability? It would, of course, be impossible to put the direction of all research into the hands of an elected committee or a dictator. Yet a certain degree of control is required, and this is best exercised by general opinion reflected in the minds of those who direct in various ways the expenditure of money on research. The only way to facilitate the growth of a general opinion which is sound is to insist that a general account shall be given which is intelligible to a sufficient number.

These considerations tempt me to ask whether it is necessary that our *Transactions* and *Proceedings* should contain so much as they do at present. When a new departure in experiment or theory is made or a new fact is discovered or a new correlation, it is right that a careful and complete explanation should be given; and if this is not too long, it is excellent that it should appear in the *Proceedings*. If the novelty leads, as it often does, to a steady output of observation, extension, confirmation and illustration, with many figures and bulky tables, there must come a time when complete publication to the world becomes unnecessary and even tiresome. What the scientific world wants is a general account of progress made, so that its bearing may be clear. A mass of details in continuation is of interest to other workers engaged in the same research, but very few others want the full account. The *Proceedings* should contain papers of original discovery or fresh departure; as regards continuation papers, as they might be called, summaries properly written should be enough. Continuation papers should, of course, be preserved and at least be available on demand; still better, a few hundred full-sized photograph copies could be made. This could be done at a fraction of the cost of printing, especially if the printing is difficult, full of figures and symbols. The *Proceedings* would then be much reduced in size, and would be more handy, interesting and useful.

There is a further consideration of no small practical importance. A largely attended conference on documentation was held a few months ago at Oxford. The subjects with which it dealt were of comparatively modern importance, but were clearly of the greatest interest in a number of places, particularly in patent offices, and in the libraries of industrial research associations. The summaries of papers in scientific journals came in for much adverse comment, comment which seemed to be entirely just. The point was that summaries were written for the expert only and were often barely sufficient at that.

Finally, if the scientific worker is no longer to be content merely to observe and to record, but also to share his knowledge with the world in general, he needs certain qualifications and a certain education which are much less necessary in the more restricted field. He is dealing not only with facts but with men; his work enters the humanities. This is really a very great matter. It draws its importance from the tremendous consequences of the increase of the knowledge of nature which are now obvious. Lord Rayleigh has lately shown the absurdity of the charge that scientific men are responsible for the evil uses that are sometimes made of their discoveries. But this responsibility is theirs, that they shall explain what they find so that their fellow men know how they stand The scientist can not be expected to see that discovery is rightly used, but no one except himself can rightly describe it It is not to be expected that the best use will be made of what is imperfectly understood.

These are problems of tactics They can not be fully solved while school and college still maintain an artificial division between two forms of teaching, naming one of them science and the other "humanities" They have far more in common than is generally recognized. There must, of course, be specialization, a divergence in the later stages. But the men of different types of mind must be kept together more than at present, so that when they meet in after-life they can understand each other. It happens too often now that the administrator makes mistakes because he can not understand his technician's advice, and the technician is incapable of expressing himself so that his administrator understands him. There ought not, in fact, to be a sharp distinction between the two. It is a fundamental point that humanities and science have joined hands in the service of mankind.

SUMMARY STATEMENT OF THE ACTIVITIES OF THE NATIONAL RESEARCH COUNCIL, 1937-1938

By Dr ROSS G. HARRISON
PRESIDENT
and
ALBERT L BARROWS
EXECUTIVE SECRETARY

BORDERLAND PROBLEMS

AMONG new activities of the National Research Council during the year, 1937-1938, a number of undertakings reflect the consideration which has been given in the Council for several years to so-called "borderland problems" These problems lie on the fringe of interest of the traditional fields of the fundamental sciences or in between these fields Perhaps they might better be called problems of the combined sciences, since it is frequently the contributions from several adjacent fields which are amalgamated into the solution of these problems They seem to arise particularly at this time partly because of the rapidly expanding range of scientific interests and partly because of the necessary use of knowledge from several sources in order to meet the increasingly complex social and technological questions of the day

In the life sciences, for instance, due to the discussion of problems of common interest in conferences of the preceding year and to suggestions from other sources, several new combination projects have been undertaken Among these is a reorientation of previous concern of the Council in parasitology under a new Committee on Medical Problems Common to Animals and Man. Others relate to the genetics of pathogenic organisms, to problems of cellular physiology and the changes in organisms due to old age, to aerobiology, and to the bearing of the results of studies of experimental neuroses upon problems of neurotic behavior and other researches in psychiatry

In the relationships between physical and earth sciences certain problems of geology have led to undertaking the preparation of a handbook of the physical and chemical constants of the materials with which geologists have to deal, and to the coordination of studies of the movement of water currents of different densities through reservoirs and lakes. The scrutiny, itself, of the field of geology in the light of its physical and chemical phases has led also to the definition of a considerable list of other geological problems.

FELLOWSHIPS

A recently published list of the fellows of the Council for the past twenty years names 1,146 past and present fellows. Of these 263 (about 23 per cent.) carried on their fellowship work abroad or will do so. The total group was derived, with respect to undergraduate training, from some 260 educational institutions in the United States and Canada and from about twenty-five educational institutions abroad. The fellows have worked in about fifty universities and at many of the research institutions on this continent and at a large number of educational and research institutions abroad, mainly in European countries. Most of the past fellows are engaged in research work and over three fourths of the group are connected with research or educational institutions. For the current year 42 fellows are under appointment, selected last spring from 189 applicants. The fellowships are supported by funds provided by the Rockefeller Foundation.

SCIENTIFIC AIDS TO LEARNING

In the spring of 1937 the Council appointed a Committee on Scientific Aids to Learning at the suggestion of the Carnegie Corporation. The purpose of this committee is to aid in the adaptation for educational purposes of the scientific and technological advances of recent years in such fields, among others, as radio, motion pictures, sound recording and reproduction, photography including microphotography for documentary purposes, and improved forms of calculating machines for the analysis of data for special research uses. While these new developments in science and technology find their application to the learning process in many fields the committee is concerned primarily with the classroom at its various levels and with research work. It is because these scientific aids to learning are relatively new and their educational uses are largely unexplored that their characteristics, possibilities and limitations need to be carefully studied in order that the best advantage can be taken of their potentialities in the educational process.

The program of the committee includes a study of the cost of furnishing auditory aids in the classroom, a study of broadcast receivers for school use, a study of the actual use of broadcast programs in the schools of a number of cities, the preparation and testing of phonograph records as aids to teaching particularly in rural areas, a similar experiment with sound slide films, a study of school experience with motion picture projection equipment, a report on equipment and supplies for microphotography, the consideration of a program for testing eye fatigue in the reading of micro-film, and assistance in the development of a highly specialized machine for the solution of mathematical problems involved in certain psychological investigations. The funds for the support of these investigations are supplied by Carnegie Corporation. Special offices are maintained by the committee in New York City (41 East 42d Street).

MONOGRAPHS IN THE PHYSICAL SCIENCES

For many years the Division of Physical Sciences of the Council has maintained a program of publication for monographs upon current research topics in the advancement of the physical sciences. These publications include a series of six monographs upon the physics of the earth, and single monographs upon such topics as the quantum theory, problems of acoustics, theories of magnetism, radioactivity, molecular spectra in gases, the scale of the universe, celestial mechanics, hydrodynamics, critical potentials, chemiluminescence, algebraic numbers and functions, and the numerical integration of differential equations. In addition to these treatises certain bibliographies and other aids to research in these fields have been produced.

These treatises have been prepared under the sponsorship of special committees and many of the treatises consist of contributions from several authorities upon various aspects of the subject discussed. Most of the monographs have been issued in the *Bulletin* series of the Council. Some have been published commercially. The expense of the editorial preparation and publication of these books was met in the earlier years from appropriations from the Rockefeller Foundation. Later the Council added funds for this purpose and a considerable sum is still on hand accumulated from the sale of these *Bulletins*, which is to be used as a rotating fund for the publication of later monographs of this nature. Four of the books were published through a special revolving fund set up for the printing of mathematical books. For two of the monographs in the general series second editions have been issued, two others have been reprinted, and two have been translated into European languages. Altogether some 43 volumes have been issued in these ways. During the past year the seventh member of the series upon the physics of the earth, "Internal Constitution of the Earth," was completed, and this monograph is now in press. Several other monographs are also in preparation.

HIGHWAY RESEARCH

The work of the Highway Research Board in cooperation with the U. S. Bureau of Public Roads has been continued in accordance with its former program for coordinating information and encouraging investigations upon the planning, building and operation of highways. The seventeenth annual meeting of the board was held in Washington, D. C., on November 30 and December 1–3, 1937, with an attendance of about 475. Selected papers presented at this meeting have recently been published in a volume of *Proceedings* of some 534 pages, with a supplement upon "Soil-Cement Mixtures for Roads." The Board also issues a monthly serial, *Highway Research Abstracts* (in mimeographed form).

During the past year at the special request of the Bureau of Public Roads the board has devoted particular attention to the problem of highway safety. These studies have been carried on in cooperation with the highway organizations in a number of the states. The results of the studies were made the basis of the following series of reports presented to Congress by the bureau last spring:

Part 1: Non-uniformity of State-Motor-Vehicle Traffic Laws.
Part 2: Skilled Investigation at the Scene of the Accident Needed to Develop Causes.
Part 3. Inadequacy of State-Motor-Vehicle Accident Reporting.
Part 4: Official Inspection of Vehicles.
Part 5: Case Histories of Fatal Highway Accidents.
Part 6: The Accident-Prone Driver.

Among recommendations in these reports attention was called to the need for (1) greater uniformity in motor vehicle traffic laws, (2) standardized methods of reporting highway accidents, (3) improved inspection services for cars, and (4) the expansion of highway patrol organizations. The studies have disclosed that our present knowledge of how and why highway accidents occur is wholly inadequate for a successful study of the problem of highway safety, especially with respect to the habits, capabilities and limitations of automobile drivers. These studies are being continued during the current year with special attention to (1) methods of testing drivers for proneness to accident, (2) speed control on rural highways, and (3) the analysis of case histories of fatal accidents.

In addition to the work of the Highway Research Board the Committee on the Psychology of the Highway of the Council's Division of Anthropology and Psychology has formulated a program of investigations upon (1) the drinking driver in relation to licensing authorities, (2) the effects of fatigue on driving performance and its relation to hours of labor, and (3) problems of headlight illumination.

INDUSTRIAL RESEARCH INSTITUTE

It is hardly more than fifty years since the first research laboratory was established by an industrial firm in the United States. The great development, however, of the industrial laboratory has taken place within the last twenty years, and at present there are well over 1,700 such laboratories in this country. Aside from technological matters, these laboratories have many problems of organization and management in common arising from the urge for making the industrial research unit render its maximum effectiveness to the concern of which it is a part, and for making the best use of the results of research work. While in industry the ultimate test is efficiency, the verdict as to what constitutes efficiency often depends upon how far to look ahead.

In order to provide a medium in which directors of research laboratories might study cooperatively these problems which are alike in many establishments, the Division of Engineering and Industrial Research organized last spring an Industrial Research Institute. This is a self-sustaining organization, under the auspices, at present, of this division of the Council. Its purpose is to provide coordinated facilities for examining common problems and for the compilation of information relating to industrial research developments and to the organization of research agencies in industry. Among the questions to which this institute will give attention are problems of research personnel and its working conditions as distinguished from production personnel, the selection and training of research men, laboratory construction and management, the keeping of research records, planning research budgets as separate from manufacturing budgets, means for keeping informed upon current progress in industry, and cooperation with universities and other research institutions. The institute is to hold several meetings a year. It carries on its studies in part through committees of its own membership and in part through special investigators.

REPRODUCTION OF RECORDS

The work on the reproduction of records, which is being conducted at the National Bureau of Standards in cooperation with an Advisory Committee of the Council, grew out of earlier investigations at the bureau upon the preservation of papers. This work has been turned during the past three years to studies of the durability of photographic film which is coming into increasing use for record purposes. Certain of these investigations have been devoted to the comparison of the usual emulsion-coated acetate film with a Cellophane-base film containing a light-sensitive dye for formation of the record image within the film. Other studies have covered the aging effects of light on film, preservatives and protective treatments to prevent scratching, favorable conditions for the storage of film, methods of testing the condition of old film, shrinkage and expansion of film and paper, especially that used in aërial photography, means for more completely removing hypo in the processing of film and a study of the effects of a small quantity of unstable cellulose nitrate usually present in the slow-burning or safety type of acetate film. The next stages of the work will be to arrange for the confirmation of findings recently obtained in testing the resolving characteristics of various types of film, to carry these resolution tests further by using a number of available commercial devices and to plan tests for the characteristics of commercial apparatus for photographing documents.

The investigations upon the preservation of paper were supported by the Carnegie Corporation cooperatively with the bureau, as were also the earlier stages of work upon record film. These studies for the past year, however, have been supported by contributions from the film and apparatus industry.

(To be concluded)

OBITUARY

MALCOLM LYONS

Malcolm Lyons, instructor in animal industry of the University of Arkansas, was accidentally shot while hunting on Thanksgiving Day (November 24, 1938), thus ending a most promising scientific career. Although only 27 years of age, Lyons had published a number of excellent scientific papers in such journals as SCIENCE, *Journal of Nutrition*, *Poultry Science* and the Experiment Station bulletin series of the Kentucky and Arkansas Stations.

Lyons possessed a keen analytical mind and a deep devotion to research. Although teaching ten hours a week at the time of his death, the head of his department stated that he was actually conducting more research than many other men with no teaching duties to distract them. He worshipped truth and detested inaccuracy and error. He conquered the obstacles that were in his way and forged on toward the goal he had set for himself. He was thorough, energetic, conscientious and dependable. He set a splendid example for his colleagues and students which was a constant challenge to them to serve science with the same loyalty he had shown.

Lyons graduated from the University of Kentucky in 1932 with the degree of B.S. in Agriculture. In 1934 he received his M.S. at Iowa State College, where he served as research fellow in animal nutrition. He served the Kentucky Experiment Station as research assistant for more than two years and the Arkansas Station for a year and a half. In the 1938 summer-term he completed the residence and course requirements at Iowa for the doctor's degree, which he would have received during the present academic year after writing his thesis, the experimental work for which had been completed.

Lyons was greatly admired by all who knew him, and he leaves a host of friends who share the loss with his bereaved family. He is survived by his wife, an eighteen-months-old daughter, his parents and two sisters.

J. HOLMES MARTIN

UNIVERSITY OF KENTUCKY

YNES MEXIA

YNES MEXIA'S death on July 12, in Berkeley, California, closed a career as a botanical collector of note. Born in Washington, D. C., May 24, 1870, during the residence of her father, General Enrique A. Mexia, there on official status from Mexico, she spent the early half of her life in the United States and Mexico, making San Francisco her home for the last thirty years. Always interested in plants, she began actively collecting in 1922 in Mexico. She usually went to remote places, however difficult to reach, the Pongo de Manseriche by raft and canoe, eastern Ecuador by pack oxen, eastern Oaxaca afoot. She prepared her specimens carefully and gave abundant notes. She collected approximately 9,300 numbers, from 140,000 to 150,000 specimens and over 500 new species, the last collection being yet unidentified. Many new species and one new genus were named in her honor.

A list of her expeditions with approximate numbers follows: 1922 Mexico; 1925 Mexico, 500 numbers, 3,500 specimens; 1926–27 Mexico, 1,600 and 33,000; 1928 Alaska, 365 and 6,100; 1929 Mexico, 315 and 5,000; 1929–32 Brazil-Peru, 3,200 and 65,000; 1934–37 South America from Ecuador to Tierra del Fuego, 2,200 and 19,900; 1937–38 Mexico, 700 and 13,000.

The most complete set of her plants is in the herbarium of the University of California; also complete records of her trips and collections.

N. FLOY BRACELIN

RECENT DEATHS AND MEMORIALS

WILLIAM BAKER DAY, since 1919 dean of the College of Pharmacy of the University of Illinois, died on December 10. He was sixty-seven years old.

DR. GEORGE VAN NESS DEARBORN, chief of the Department of Medical Psychology of the U. S. Veterans Administration, has died at the age of sixty-nine years.

DR. JOSEPH A. HILL, for more than forty years a statistician with the Bureau of the Census, died on December 12. He was seventy-eight years old.

A CORRESPONDENT writes: "News has been received of the death at the age of thirty-one years of L. G. Schnirelman, professor of mathematics at the University of Moscow and a member of the Mathematical Institute of the Academy of Sciences of the U.S.S.R. Schnirelman had made first-rate contributions in widely separated branches of mathematics (topology, the calculus of variations, number theory). No branch of science has reached a higher distinction in the U.S.S.R. than mathematics, and the deceased was one of its strongest and most original mathematicians."

THE U. S. Board on Geographical Names has named a mountain 9,900 feet high in Yellowstone National Park Mount Hornaday in honor of the late Dr. William T. Hornaday, until his retirement in 1926 director of the New York Zoological Park. Mount Hornaday is on the divide at the head of Plateau Creek and is visible from the northeast park entrance road.

SCIENTIFIC EVENTS

THE PROPOSED CANCER SERVICE IN GREAT BRITAIN

A BILL embodying a new plan for securing earlier and more effective treatment of cancer involving the establishment of a cancer service which will make the best modern facilities for diagnosis and treatment available in every part of the country has been formally introduced in the British House of Commons.

According to the London *Times* the government has decided to place on county and county borough councils, either singly or in regional groups, the duty of securing adequate facilities for the diagnosis and treatment of persons suffering, or suspected to be suffering, from cancer. It is estimated that at present only one case in four which might hopefully be treated by modern methods is so treated.

These major local authorities will be required to submit their arrangements for the minister's approval within a reasonable time. Before doing so they will consult the Radium Commission and representatives of the voluntary hospitals and the medical practitioners in each locality. It is proposed to have diagnostic centers at which expert clinical advice on a team basis will be available to all. In general these centers will be in the large towns, and patients will come to them from the surrounding areas. Facilities for treatment will be provided in voluntary hospitals, whose services it is hoped to utilize to the utmost, or in hospitals under the control of local authorities. The government intends to bring the most modern methods of treatment, whether by surgery, radium or deep x-rays —alone or in combination—within the reach of every sufferer. This will mean the provision of additional facilities for treatment at appropriate local centers, both by developing existing centers and providing new ones.

It is estimated that when the service is in full operation the total additional expenditure will amount to about £600,000 a year for England and Wales and £100,000 for Scotland. In meeting this expenditure local authorities will be assisted by exchequer grants which will be approximately equivalent to 50 per cent. of the additional cost incurred. But the grant will be made according to the "weighted population" formula, and the 50 per cent. will be scaled up or down according to the needs of the area. In some of the poorest areas the exchequer grant will amount to 80 per cent. It will probably take four or five years before the cost of the service reaches £700,000 a year. At first there may be some scarcity of the skilled workers needed.

The bill enables the Minister to lend up to £500,000 to the National Radium Trust for the purchase of radium and other radio-active substances and of equipment for radio-therapeutic treatment. The trust has already arranged an option for a substantial purchase of radium from Canada at a fixed price over the next five years. The bill will prohibit the dissemination of advertisements for "cancer cures" to the lay public.

COMMITTEE OF THE BRITISH ASSOCIATION ON THE SOCIAL RELATIONS OF SCIENCE

As has been stated in SCIENCE, at the recent meeting in Cambridge of the British Association for the Advancement of Science, there was formed a committee on the Division for the Social and International Relations of Science. The committee, under the chairmanship of Sir Richard Gregory, includes the president and general officers of the association *ex officio* and

Sir Daniel Hall, Sir Frederick Gowland Hopkins, Sir John Russell and Lord Stamp (*vice-chairmen*), Professor F. C. Bartlett, Professor J. D. Bernal, Professor P. M. S. Blackett, Mr. Ritchie Calder, Mr. A. M. Carr-Saunders, Professor S. Chapman, Dr. C. H. Desch, Professor A. C. G. Egerton, Professor H. J. Fleure, Mr. E. W. Gilbert, Professor N. F. Hall, Mr. R. F. Harrod, Professor A. V. Hill, Sir Clement Hindley, Professor L. Hogben, Dr. L. E. C. Hughes, Dr. J. S. Huxley, Mr. D. Caradog Jones, Professor H. Levy, Dr. C. S. Myers, Mr. Max Nicholson, Sir John Orr, Professor J. C. Philip, Professor J. G. Smith, Professor R. G. Stapledon, Professor F. J. M. Stratton, Professor F. E. Weiss, Mr. H. G. Wells, Mr. J. S. Wilson and Dr. S. Zuckerman.

The London *Times* states that a circular has been prepared for issue to institutions at home and abroad, indicating the main purposes of the division as "the objective study of the effects of advances in science on communities, and reciprocally the effects of social conditions upon the progress of science; and the encouragement of the application of science to promote the well-being of society." The committee is empowered to arrange meetings of the division, to coordinate work dealing with the social relations of science, both at home and abroad, to be prepared to act in a consultative capacity and to supply information to organizations, individuals and the public, to initiate and carry out inquiries and research and to secure their publication.

Two of the most important functions of the division will be to coordinate the large amount of work which has already been done or undertaken by numerous existing organizations, and to make the best use of the association's platform to bring the results of such work before the public. It is hoped to cooperate with the International Council of Scientific Unions, which has already set up a Committee on Science and its Social Relations with a view to preparing a report of world-wide scope.

BIOLOGICAL ABSTRACTS

A RECENT issue of SCIENCE[1] contained the announcement of the 1939 publication plan for *Biological Abstracts*. Under this plan there is to be a breakdown into five parts according to subject-matter, ranging in cost from $4.00 to $9.00, with $25.00 the charge for all parts brought under one cover.

During the next year, as during the current one, it is hoped that societies will continue their contribution of $2.00 a member toward the support of *Biological Abstracts*. It is highly desirable that this support be given during the transition period to the new plan, which has won well-nigh universal approval. For the present year five societies took such action, while several others approved a request for voluntary pledges by their membership. All such contributions will be counted toward the subscription price of a section or the total edition, and no contributor is expected to make more than one such donation even though a member of more than one contributing society.

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[1] SCIENCE, 88: 294, 1938.

For the year 1938 such contributors have the option of either receiving the index to volume 12 or of deducting $2.00 from their personal subscription to that volume (provided their institution now subscribes). The same privilege is accorded to the contributors of past years; that is to say, a 1936 contributor, for example, can have his contribution applied to the purchase of volume 10.

Now that 1938 nears an end, it is desirable that each contributor inform the Business Manager of *Biological Abstracts* at the University of Pennsylvania what option he selects.

The Board of Trustees wishes to express its appreciation to the members of the five societies which have voted contributions this year:

American Physiological Society
American Society of Naturalists
American Society of Zoologists
Ecological Society of America
Genetics Society of America

as well as to those individuals of other societies who made a voluntary contribution or outright donation.

The Board of Trustees of *Biological Abstracts* consists of G. S. Avery, Jr., H. P. Barss, A. F. Blakeslee, P. R. Burkholder, A. J. Carlson, A. B. Dawson, H. B. Goodrich, A. P. Hitchens, D. D. Irish, M. L. Raney and G. W. Hunter, III, *President*.

INTERNATIONAL CONTEST OF THE SCIENTIFIC APPARATUS MAKERS OF AMERICA

ENGINEERS representing all industries, from every section of the United States and three foreign countries, sent in entries to the First Instrumentation Contest sponsored by the Industrial Instruments Section of the Scientific Apparatus Makers of America and conducted by Richard Rimbach, publisher of *Instruments* (the magazine of measurement and control). The contest closed on November 15 and the judging was held on December 6 at the Hotel Commodore, New York City.

Prizes were awarded as follows:

First Prize $200.—F. K. Vial, vice-president in charge of research, Association of Manufacturers of Chilled Car Wheels, Chicago, "Automatic CO_2 Compensator for Cupola Control."

Second Prize $100.—R. K. Hellmann, electrical engineer, Transatlantic Research, Inc., New York City, "An Audio Frequency Spectrometer."

Third Prize $50.—Wilton E. Stackhouse, technician, United Gas Improvement Company, Philadelphia, "A Hydrogen Sulphide Recorder."

Fourth Prizes $25 each.—George B. Bailey, president, Thermal Engineering Company, Boston, "Automatic Control Applied to the Diesel Engine"; H. A. Kleinman, engineer, United Power Manufacturing Company, Moline, "Application of a Multi-Pointer Gage for Speed Measurement"; M. G. Mastin, chemical engineer, Westvaco Chlorine Products Corporation, South Charleston, "A Sensitive Method of Flow Control"; Walter E. Smith, technologist, C. Brewer and Company, Ltd., Honolulu, "Sugar Boiling by Instrument Control."

Fifth Prizes $10 each.—Sherman Chase, steam engineer, Carnegie-Illinois Steel Corporation, South Chicago, "Relative Volumetric Gas Analysis by Cascaded Absorption and Oxidation Recorded by a Pressure Recorder"; Harry C. Gray, stress analyst, Wright Aeronautical Corporation, Paterson, N. J., "Sound Frequency Measurement"; G. J. Gross, transmission engineer, Pennsylvania Water and Power Company, Baltimore, "Ground Megger Signal Generator in Locating Buried Conductors"; Wm. B. Hess, test engineer, Safe Harbor Water Power Corporation, Conestoga, Pa., "The Steam Engine Indicator Differential Pressure Gage"; Charles Wasserman, technological assistant, Consolidated Gas, Electric Light and Power Company, Baltimore, "An Unusual Application of a General Electric Torque Balance Watt-Telemeter."

GRANTS-IN-AID FOR STUDIES IN SCIENCE INSTRUCTION

THE second meeting of the Committee for the Improvement of Science in General Education[1] of the American Association for the Advancement of Science was held in Chicago on December 3 and 4. A partial statement of the agenda upon which the committee worked will appear later. One of its responsibilities is assuming proportions which seem to warrant this separate statement.

It will be recalled that among other things the committee was charged with the following task. "To obtain and to use financial support for such work in the sciences as gives promise of being effective in improving the teaching of science in general education." At the Chicago meeting the committee considered the reception and preliminary evaluation of experimental projects on teaching of the sciences at college and university level. In all such cases the appropriations requested are likely to exceed the funds that are available for such purposes, a situation which will evidently develop in this case also. Nevertheless, the committee invites correspondence from teachers of science who have teaching experiments under way or seriously contemplated, which would be facilitated by grants-in-aid. Naturally, any one requesting such grants will expect to defend their necessity or appropriateness and to furnish evidence that the conditions under which the proposed experiments are to be performed are favorable to their advantageous prosecution.

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[1] SCIENCE, 87: 454, 1938.

The preliminary "blueprint" of the field that may be covered to advantage by a series of experiments in the teaching of the sciences will be completed by June 30. Projects to be considered must be in hand not later than May 20. Correspondence may be initiated with any member of the committee. There will be some advantage in selecting one of the members whose field of professional competence includes that within which the proposed project falls.

The fact should be borne in mind that only projects designed to improve the teaching of science in general education are to be submitted. Improvement in preparation of "majors" in the various sciences or, in general, the strengthening of specialist education is outside the purview of this committee.

The members of the committee, grouped by subjects, are as follows:

Botany: Professor H. C. Sampson, the Ohio State University; Professor P. B. Sears, Oberlin College, Oberlin, Ohio.

Chemistry: Professor C. C. Furnas, Yale University; Professor N. E. Gordon, Central College, Fayette, Mo.; Professor W. C. Johnson, University of Chicago; Professor O. M. Smith, Agricultural and Mechanical College, Stillwater, Okla.

Education: Professor H. J. Arnold, Columbia University; Professor R. W. Tyler, University of Chicago.

Geography and Geology: Professor Carey Croneis, University of Chicago; Professor Kirtley Mather, Harvard University.

Mathematics: Professor J. S. Georges, Wright Junior College, Chicago; Professor E. R. Hedrick, University of California at Los Angeles.

Physics: Professor C. J. Lapp, State University of Iowa; Professor L. W. Taylor (*chairman* of committee), Oberlin College.

Zoology and Biology: Professor Bert Cunningham, Duke University; Professor M. F. Guyer, University of Wisconsin; Professor A. C. Kinsey, Indiana University.

THE WASHINGTON MEETING OF THE INTERNATIONAL UNION OF GEODESY AND GEOPHYSICS

CHESTER R. LONGWELL, chairman of the Committee on Coordinated Interests of Yale University, reports that as one step in the arrangements for the approaching assembly of the International Union of Geodesy and Geophysics in this country, the following letter has been sent to more than two hundred institutions and organizations, including universities, colleges, research institutions, Federal and state scientific bureaus and commercial corporations. The letter is printed here with the thought of extending the invitation to other organizations and individuals who may be interested but have not been reached directly by the letter, which reads:

> No international scientific association covers a broader field of interest than the Union of Geodesy and Geophysics. The union is made up of seven constituent associations, devoted to geodesy, seismology, meteorology, terrestrial magnetism and electricity, physical oceanography, volcanology and hydrology. Physicists, geologists, geographers, astronomers and many types of engineers, in addition to specialists representing the particular fields suggested in names of the associations, find a common meeting ground in the union, which owes its origin and its continued growth to the interlocking problems crossing the borders of the several physical sciences in all the countries. The meetings of the union, held at three-year intervals, not only promote international cooperation in scientific enterprises but also help materially to foster international good will.
>
> The International Union of Geodesy and Geophysics will meet in Washington, D. C., September 4 to 15, 1939. Official host for the meeting will be the American Geophysical Union, in cooperation with the National Research Council. The twelve days of the Washington session will be occupied with assemblies of the union as a whole, meetings of the constituent associations and receptions. Before the session there will be three organized trips to various parts of the country. It is expected that a large number of foreign delegates will attend the session, representing the member countries, of which there are 36 besides the United States. Probably there will be an especially large attendance from all sections of this country, representing not only the Geophysical Union but also numerous scientific and educational institutions.

Professor Longwell writes:

> Practically every institution in this country that supports physical science in any form has a logical interest in the Washington meetings of next year. The American Geophysical Union urges that you join as far as possible in playing host to our fellow scientists from other countries in making the session successful. In particular, we shall be happy if you will discuss this matter with individual scientists and departments of science in your institution, and name one or more delegates to represent your institution at the meetings of the union next September. We suggest that as far as possible the delegates selected be men who are actively interested in some aspects of geophysics, since such men will gain most from and contribute most to the meetings. It should be added that travel and other expenses of delegates will have to be borne by the individuals or by the institutions they represent, because the union does not have any funds for this purpose.

Information about the union and its constituent associations appeared in an article by N. H. Heck on the International Union of Geodesy and Geophysics in SCIENCE, April 22, 1938. Circulars giving detailed information concerning the coming meeting will be sent to any one on request.

SCIENTIFIC NOTES AND NEWS

The doctorate of science of the University of Oxford was conferred on December 10 on Dr. Irving Langmuir, associate director of the research laboratories of the General Electric Company at Schenectady, N. Y. Dr. Langmuir delivered on December 8 the first lecture at the Royal Institution, London, under the plan sponsored by the Pilgrim Trust for interchange of lecturers between the Royal Society and the National Academy of Sciences in Washington. His subject was "Molecular Films." Sir William Bragg, president of the Royal Society, will deliver the first lecture to be given in America on April 24 at the annual meeting of the National Academy of Sciences in Washington.

A. Cressy Morrison was reelected to the presidency of the New York Academy of Sciences at the annual dinner meeting on December 14. Honorary fellowships were conferred on Professor Edwin G. Conklin, of Princeton University, executive vice-president of the American Philosophical Society; on Dr. Ross Granville Harrison, of Yale University, chairman of the National Research Council, and on Dr. Irving Langmuir, of the General Electric Company. Eighteen scientific men were elected fellows. Other officers elected were: *Vice-presidents,* Ida H. Ogilvie, Robert T. Rock, Jr., Horace E. Wood, 2d, Harry L. Shapiro and Duncan A. MacInnes; *Recording Secretary,* Frederick H. Pough; *Corresponding Secretary,* Roy Waldo Miner; *Treasurer,* Wyllys Rossetter Betts; *Librarian,* John Hendley Barnhart; *Editor,* Erich M. Schlaikjer; *Councilors,* W. Reid Blair and G. Kingsley Noble; *Finance Committee,* Herbert F. Schwarz, John D. Sherman, Jr., and Wayne M. Faunce. The speakers were Professor Victor K. LeMer, of Columbia University, who discussed the velocity of chemical reactions, and Dr. Roy Waldo Miner, curator of living invertebrates at the American Museum of Natural History, who described his expedition to the South Seas in 1936 to study pearl shell.

At the annual meeting of the New England Water Works Association, J. R. Baylis, physical chemist of Chicago, was awarded the Dexter Brackett Memorial Medal "in recognition of his outstanding work in water purification."

Dr. Hans A. Bethe, professor of physics at Cornell University, was presented with the Morrison Prize of $500 at the annual dinner meeting of the New York Academy of Sciences and affiliated societies "for the best paper on solar and stellar energy" entitled "Energy Production in Stars." Winners of two other Morrison prizes of $200 each were Dr. F. Gaynor Evans, of the University of New Hampshire, for his paper on "The Morphology and Functional Evolution of the Atlas-Axis Complex from Fish to Mammals," and Dr. Norwood C. Thornton, of the Boyce Thompson Institute, Yonkers, N. Y., for his paper on "Oxygen Regulates the Dormancy in the Potato." Funds for the prizes were provided by A. Cressy Morrison, president of the academy.

At the annual general meeting of the London Mathematical Society its De Morgan Medal was presented to Professor J. E. Littlewood, "for his contributions to mathematical knowledge."

Professor Frank B. Rowley, director of the Engineering Experiment Laboratories of the Institute of Technology of the University of Minnesota, a former president of the American Society of Heating and Ventilating Engineers, has been awarded the F. Paul Anderson Medal of the society, which will be presented to him at a meeting in Pittsburgh in January.

In recognition of his "distinguished services, particularly in connection with the current construction of the 392-mile Colorado River Aqueduct," F. E. Weymouth, general manager and chief engineer of the Metropolitan Water District of southern California, has been elected an honorary member of the American Society of Civil Engineers.

At a recent meeting of microbiologists at the Pasteur Institute of Paris, Professor Martin, director of the institute, conferred the insignia of the grand cross of the Legion of Honor on behalf of the French Government on Professor Jules Bordet, director of the Pasteur Institute of Brussels, in recognition of his work on immunology.

Dr. W. K. Hatt, research professor of Purdue University, will retire on January 1 with the title of emeritus professor of civil engineering after forty-five years of service. Following a short period of travel to Australia he will maintain residence at Purdue University.

Word has reached this country that the editor of the *Zentralblatt für Mathematik und ihre Grenzgebiete,* Professor Otto Neugebauer, now of Copenhagen, has resigned. The resignation from this mathematical abstracts journal was occasioned by the action of the publisher, Julius Springer, of Berlin, in dropping Professor Levi-Civita, of Italy, from the board without the knowledge of the editor, as well as by the demand that the editor give assurance that no emigrants would be allowed to referee articles by German authors. In consequence of this interference with editorial policies, the associated editors resident in America, Professors Courant, Tamarkin and Veblen, have tendered their resignations, as have also a number of associate editors and collaborators in other countries.

Lieutenant Commander Francis W. Reichelderfer has been appointed acting chief of the U. S. Weather Bureau, succeeding Dr. Willis R. Gregg, who died last September. Commander Reichelderfer had charge of reorganizing and developing the Naval Meteorological Service. In 1928 he was assigned to the Naval Air Station at Lakehurst, N. J., and later served as meteorologist on several flights and expeditions.

Dr. Ross T. McIntire, for the last five years White House physician, has been appointed surgeon general of the Navy with the rank of rear admiral. He has held since June, 1934, permanent rank of commander, and was appointed medical inspector with the rank of captain in 1935, to remain in effect during his assignment as physician at the White House.

Dr. Robert A. Black, professor of pediatrics, Loyola University School of Medicine, has been appointed president of the Chicago Board of Health. He will fill this position during the absence of Dr. Herman N. Bundesen, who has been granted leave pending the outcome of the government's anti-trust action against the milk industry.

Dr. H. L. Tidy has been elected dean of the Medical School, St. Thomas's Hospital, London, in place of the late Professor Leonard S. Dudgeon.

Dr. Earl D. Bond, director of the Institute for Mental Hygiene and head of the department of nervous diseases of the Pennsylvania Hospital, has resigned to devote his time to research. He will be succeeded by Dr. Lauren H. Smith, a member of the executive staff of both units since 1926. Dr. Bond will continue as vice-dean for psychiatry and professor of psychiatry at the University of Pennsylvania Graduate School of Medicine.

N. F. Waters, of the department of poultry husbandry at the Iowa State College, has resigned, to become senior geneticist at the regional laboratory for poultry research in East Lansing, Mich.

Dr. James B. Murphy, chief of the Cancer Research Division of the Rockefeller Institute for Medical Research, New York, and Dr. Mont R. Reid, director of surgical service of the Cincinnati General Hospital and professor of surgery at the University of Cincinnati, have been appointed members for three-year terms of the National Advisory Cancer Council. They succeed Dr. Francis C. Wood, director of the Crocker Institute of Cancer Research of Columbia University, and Dr. James Ewing, director of the Memorial Hospital, New York, both of whom were named as original members of the council in 1937. Other members of the council are: President James B. Conant, of Harvard University; Dr. Arthur H. Compton, of the University of Chicago; Dr. C. C. Little, managing director of the American Society for the Control of Cancer, and Dr. Ludvig Hektoen, emeritus professor of pathology of the University of Chicago.

The Ramsay Memorial Fellowship Trustees have made the following awards of new fellowships of the value of £300 for the year 1938–39: Dr. Vernon Hollis Booth, a British fellowship, tenable for two years, at the University of Cambridge; Donald McNeil, a Glasgow fellowship, tenable for two years, at the University of Glasgow; Dr. Alfred G. Epprecht, a Swiss fellowship, tenable for one year, at the Imperial College of Science and Technology, London. The trustees have renewed the following fellowships for a second year: Dr. A. E. Alexander (British fellow), at the University of Cambridge; Dr. E. de Salas (Spanish fellow), at University College, London; Dr. J. J. Hermans (Netherland fellow), at University College, London; M. Jean Monvoisin (French fellow), at the Royal Institution, London; Hazime Oosaka (Japanese fellow), at University College, London.

Dr. Harlow Shapley, director of the Harvard Observatory, has recently returned from a trip of inspection to the Boyden Station of the observatory in Bloemfontein, South Africa. After attending the meeting of the International Astronomical Union in Stockholm early in August, Dr. Shapley went to England, where he was one of the invited speakers at the Cambridge meeting of the British Association. From London he flew to South Africa. After a stay of five weeks at Harvard Kopje, he returned by boat. While in South Africa he gave addresses to the Witwatersrand University in Johannesburg, University College of Orange Free State in Bloemfontein, and the South African Association for the Advancement of Science.

Rudyerd Boulton, curator of birds at the Field Museum, Chicago, during November conducted field work in southern Mississippi, near Ocean Springs. At the invitation of Messrs. James R. Leavell and Carl A. Birdsall, of Chicago, owners of a large tract of wilderness land in this region, he participated in a preliminary natural history survey to determine the possibilities for conservation projects and special zoological studies.

Dr. Dora Ilse, who has been working for the past two years in the laboratory of Dr. Imms, at the University of Cambridge, lectured at the University of Colorado on December 3, on the reactions of butterflies and bees to colors. The lecture was illustrated by moving pictures. Dr. Ilse has also lectured at various other American universities, including Cornell, Illinois, Minnesota, Kansas, California, and at the American Museum of Natural History.

Dr. J. W. Beams, professor of physics at the University of Virginia, delivered a lecture on "High-Speed Centrifuging" before the Franklin Institute, Philadelphia, on the evening of December 15.

Sir Edward Mellanby, of Emmanuel College, Cambridge, Fullerian professor of physiology in the Royal Institution and secretary of the Medical Research Council, has been appointed Rede lecturer for the year 1939.

A graduate course on electron optics and electron microscopy will be offered by the department of physics of the University of Pennsylvania during the second semester. The course will be given by Dr. L. Marton, lecturer in physics at the university and associate of the RCA Manufacturing Company, together with Drs. G. A. Morton and E. G. Ramberg, of the Electronics Research Division of the company. The lectures will be given on Wednesday afternoons from five to six P.M., in the Randal Morgan Laboratory of Physics.

Recent lecturers before the department of geology and geography, Northwestern University, were: Dr. W. H. Voskuil, mineral economist, Illinois Geological Survey, on "Economics of Mineral Production"; Dr. Clyde P. Ross, geologist, U. S. Geological Survey, on "Cinnabar Deposits of California"; Dr. Helen M. Strong, soil conservationist, U. S. Department of Agriculture, on "Soil Conservation Methods"; Dr. D. F. Hewett, geologist, U. S. Geological Survey, on "Mining Geology in the Western United States"; Professor Clarence F. Jones, School of Geography, Clark University, on "South America, from the Caribbean to the Argentine"; Dr. Benjamin B. Cox, Vacuum Oil Company, on "Modern Petroleum Development"; Professor J. H. Maxson, California Institute of Technology, on "Geological Studies in the Grand Canyon of the Colorado"; Dr. Harold T. Stearns, U. S. Geological Survey, Hawaii, on "Hawaiian Volcanoes"; Dr. Takeo Watanabe, University of Sapporo, Japan, on "Japanese Geological Institutes"; and Professor G. W. White, University of New Hampshire, on "Novya Zemlya."

The Eastern railroads have announced a reduction in rates from December 15 to January 10 with the usual stop-over privileges for those expecting to attend the meeting of the American Association for the Advancement of Science in Richmond, Virginia, from December 27 to 31. Round-trip railway coach fares will be reduced by 20 per cent., to two cents per mile. Pullman fares will be reduced by 10 per cent. to 2.7 cents per mile.

The Western Chemical Congress will meet in August, 1939, during the Golden Gate International Exposition. A number of societies, associations and industrial corporations are interested in planning for the congress and are cooperating with a committee of technologists on the Pacific Coast. The major theme is stated as "The Place of Chemistry in Modern Life," and it has the object to foster advancement of chemical knowledge and development of chemical process industries in the West. Facilities are to be arranged for separate meetings of the various societies and associations participating.

It is announced that the new electroencephalographic laboratories of the Montreal Neurological Institute will be opened during the first week of January. The work to be done in these laboratories has been made possible by a grant from the Rockefeller Foundation to promote research in epilepsy and dementia. Funds contributed by a group of Montrealers, who have been interested in the institute since its inception, provided for the building of an extension necessary for this work. Since the opening of the institute in September, 1934, extensive researches in epilepsy have been carried out under the direction of Dr. Wilder Penfield, director of the institute and professor of neurology and neuro-surgery at McGill University. The electroencephalographic laboratories will be under the direction of Herbert H. Jasper, Ph.D. (Iowa), D. ès Sci. (Paris). Dr. Jasper, after post-graduate work in Iowa and Oregon, studied for two years at the Sorbonne. Previous to going to Montreal he was assistant professor of psychology at Brown University and director of the Neurophysiological Laboratories and the Psychological Clinic at Bradley Hospital, Providence, R. I.

A statute was promulgated on November 1 at the University of Oxford, establishing the Edward Grey Institute of Field Ornithology and providing accommodation for it at 39, Museum Road. Its functions will be to carry out research into problems of ornithology with special reference to the numbers, distribution, movements, habits and economic status of British birds, to collect, coordinate and supply information on these subjects obtained from published sources and from field observers, and to publish the results of its work by means of printed papers, informal instruction or lectures.

Courses in television have recently been planned by the Radio Corporation of America. For those who have had no previous training in radio engineering the course requires a period of two years in the day school or five years in the evening school. Special Television Units of six months duration in the day school or of one year in the evening school are available to applicants possessing adequate technical background.

DISCUSSION

MULTIPLE STROKES IN LIGHTNING

THE recent interesting note by H. L. Dean on "Stroboscopic Illusions caused by Lightning"[1] prompts me to report a somewhat similar series of observations, which also included an impromptu measurement of the average interval between successive discharges in a multiple stroke.

These observations were made by the writer in the evening of June 8, 1938, while driving westward in gathering dusk through a rainstorm, in that part of northwestern Oklahoma which is called "The Panhandle." The country is table-like, treeless and sparsely settled. The road was excellent, and deserted, so that for twenty miles or more (during which no hills and only two curves were encountered) the machine was held at such a uniform speed that the period of the windshield wiper was very nearly constant. In the gathering night, the wiper blade could be seen only indistinctly except when illuminated by lightning. During a particularly brilliant flash, it was noticed that the wiper blade was executing an apparently stepwise movement (such as is sometimes seen when the blade and windshield are dry), although close inspection in the weak but steady light of twilight showed that it was moving steadily and smoothly on the thoroughly wet glass. Thereupon, the illusion of interrupted movement was recognized as the result of a periodic interruption in the source of illumination.

This observation of the stroboscopic behavior of the blade was made not less than 15 times during the storm. Not every flash showed the pulsating or multiple character. Nor did all flashes occur within those directional limits which permitted satisfactory observation. Presumably, in such a level, treeless area, many flashes are strokes to ground; and McEachron points out[2] that a high percentage of strokes to ground are multiple.

During a multiple flash the wiper blade appeared at 4 points (sometimes only 3), more or less uniformly spaced and all together occupying an arc which was about one third of the swing of the blade. Retinal retention and the duration of the flash may have mixed effects toward determining the number of blade images seen. Retinal fatigue also made it apparent that the intervals between the pulses were not quite uniform in length.

A count of the swings of the wiper showed it to be making from 115 to 120 half-vibrations per minute. The half-period was thus approximately 0.5 sec. The time occupied by the 4 blade images in one third the arc of the blade was 0.17 sec. Thus the average interval between the maxima of two successive pulses was 0.04 second.

This rough measurement, made with apparatus at hand, is not in disagreement with precise measurements made by McEachron and McMorris[3] from photographs made with a moving-lens camera employing the general principle of the Boys camera. Of 9 intervals which they recorded in a typical multiple stroke, the 5 intervals, 0.029, 0.028, 0.024, 0.022 and 0.053 sec., are of the same order as the 0.04 second reported here. Holzer, Workman and Snoddy[4] also report intervals as large as 0.033 and 0.047 sec., but they do not give the distribution of the intervals which they recorded.

The data given here are from a note-book entry of June 10, 1938. In consideration of the well-known detrimental effect which *prae judicio* knowledge may have upon any measurement in which the human factor is high, it may be noteworthy that at that time the observer had no information concerning the lengths of flash intervals, although he was aware that such data had been published.

H. M. DAVIS

SCHOOL OF MINERAL INDUSTRIES,
THE PENNSYLVANIA STATE COLLEGE

TYROSINE DETERMINATION

THE recent article by Reiter[1] raises the question as to whether the value given for the tyrosine content of egg albumin of 3.72 per cent. is to be taken as correct rather than the earlier values found by Looney[2, 3] of 4.20 and 4.10 per cent. If we assume that egg albumin has a molecular weight of 33,800 as proposed by Cohn[4] and contains 8 molecules of tyrosine, the calculated percentage composition would be 4.28. If the value of 35,700 given by Bergmann[5] is correct, then the theoretical percentage becomes 4.06. The value of 4.10 given by Looney[3] would appear to approach the theoretical value more nearly than the lower values given in the literature by other methods, and therefore the original method of Folin and Looney would still seem to be the most reliable method yet proposed. The method can also be used for 50 mg amounts of protid by reducing both the volume of the digest and also the final volume of the colored solution to 25 ml and all the reagents in proportion.

JOSEPH M. LOONEY

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[1] SCIENCE, 88: 2285, 352.

[2] *Elec. Engineering*, 53: 1633–37, 1934.

[3] *Gen. Elec. Rev.*, 39: 494, 1936.

[4] *Jour. Applied Phys.*, 9: 136, 1938.

[1] C. Reiter, SCIENCE, 88: 378, 1938.

[2] O. Folin and J. M. Looney, *Jour. Biol. Chem.*, 51: 421, 1922.

[3] J. M. Looney, *idem.*, 69: 1926.

[4] E. J. Cohn, J. L. Hendry and A. M. Prentiss, *Jour. Biol. Chem.*, 63: 721, 1925.

[5] M. Bergmann, *Chemical Reviews*, 22: 423, 1938.

A LINGUISTIC ANALYSIS OF THE SIXTEENTH INTERNATIONAL CONGRESS FOR PHYSIOLOGY

AT various international congresses, four languages are usually made official. This is especially true of the international congresses for physiology, the sixteenth of which met from August 14 to 19 last summer in Zurich. I have analyzed and classified various papers appearing on the program of that congress according to the languages in which they are presented with rather interesting results. Such a study obviously gives a sort of index to the languages most used in publishing or announcing the results of scientific investigation and also roughly indicates the amount of research carried on by the various peoples employing these mother tongues. The following are some of the statistical findings:

The total number of papers presented at the sixteenth International Congress for Physiology in Zurich last summer was 437. Of these, 211 were given in English, 143 in German, 59 in French and 24 in Italian. It is quite evident from these figures that the two languages most widely employed by the scientists were English and German, the sum of the two constituting over 80 per cent. of all the papers written. This, however, by no means indicates that a large amount of work is now being done in the Third Reich, because a further analysis of the 143 papers presented in German reveals that only 61 of these came from scientific workers in Nazi Germany; the rest of the communications in that language were read by a large number of German-speaking authors from other lands, including 10 from Czechoslovakia, 21 from Switzerland, 13 from the Netherlands, 4 from Austria, 9 from Hungary, 2 from Poland, 6 from Sweden, 1 from Norway, 3 from Palestine, 1 from Greece, 1 from Finland, 3 from Turkey, 2 from Italy, 1 from Esthonia and 1 from Belgium. Of the 211 English papers, 132 came from the United States and Canada; the rest emanated from the British Isles and other English possessions. Of the 59 French papers presented at the congress, 26 came from France, 17 from Belgium, 3 from Argentina, 1 from Italy, 2 from Poland, 1 from Portugal, 3 from Switzerland, 3 from Czechoslovakia, 1 from Serbia, 1 from Greece and 1 from Hungary. Of the Italian papers, 22 were presented by Italians; one was read by a Swiss and 1 by a Belgian.

The analysis made above becomes more interesting when it is compared with that of the thirteenth International Congress for Physiology, which met in Boston in 1929. At that congress also English and German were the dominating languages. The total number of papers listed was 585, of which 391 were in English and 106 in German, 62 in French and 23 in Italian. Of the 394 papers in English, 292 emanated from the United States, 26 from the British Isles, 14 from Canada, and the rest from other countries in various parts of the world. Of the 106 given in German, 61 (or 58 per cent. of the total) came from Germany itself. The remaining number consisted of 5 from Austria, 9 from Russia, 6 from Switzerland, 10 from Hungary, 9 from Czechoslovakia, 4 from the Netherlands and 2 from Esthonia. Of the 62 French communications, 37 came from France proper; the rest were presented by Belgians, Spaniards, Poles, Russians and Roumanians.

It is fair to assume that the number of members attending an international congress will vary inversely in proportion to the distance the individual scientists are obliged to travel from their place of origin to the place of meeting. Thus, when such a congress takes place in the United States, it is to be expected that the number of Americans and Canadians, and perhaps of English, attending the meeting will be greater than that of members coming from central Europe. *Vice versa,* when a congress meets in Switzerland, it is reasonable to suppose that a much larger number of scientists will come from such nearby countries as Germany, France and Italy than will arrive from across the water. An analysis of the members presenting papers at the two congresses, however, revealed the striking fact that there were actually just as many German papers presented at the Boston meeting in 1929 by those hailing from Germany proper as there were at the 1938 congress in Zurich. It is interesting to note that the number of French papers presented was very nearly the same at both the thirteenth and sixteenth International Congresses for Physiology; so also was the number of Italian papers.

The foregoing study warrants several tentative conclusions: First, it is obvious that the English language is more extensively used than any other as a medium of scientific communication and that the German comes second in popularity. Second, it is evident that nearly one half of the German communications made at the Zurich congress were presented not by Nazi physiologists but by German-speaking scientists widely distributed in other lands. Third, judging by the number of papers presented by Nazi physiologists at the Zurich congress as compared with the series read at the Boston congress in 1929 by scientists from Germany proper, it appears that the amount of scientific investigation (without any regard to its quality) now being done in the physiological sciences in the Third Reich is far below that produced there after the world war during the reign of democracy.

M. D.

SCIENTIFIC BOOKS

THE OPEN MIND

The Open Mind—Elmer Ernest Southard. By FREDERICK P. GAY. Publisher: Normandie House. $5.00.

IN a fascinating and excellently written biography, Dr. Gay has brought to life one of the unique and significant characters in American medicine of the past generation. This book is not merely the record of the scientific contributions to neuropathology of Ernest Southard nor the many ways in which he stimulated psychological thinking, but it is the portrait of a man whose inner vividness of *being* towered above his outer accomplishments.

To offer the reader an understanding of this singular person, the author has wisely selected much of his material from Southard's reflections about himself. Southard was irked by the fact that he was considerably over-weight, and in a letter to Mrs. Cabot remarked: "You know that in many people the soul is unlike the body—I, for instance, have a slim soul." What he was motivated by may be gathered by an excerpt from a letter to his mother: "It becomes increasingly difficult to figure out the technique of becoming a great man." The intensity with which Southard pursued the unusually wide trail of his many interests suggests that his impulse to be great sprang from an evolutionary flame that burned incessantly within him; this is revealed in Dr. Gay's book with incontestable clarity as a consuming interest in the unexplored. No one was more aware than he was himself of the multiple horizons on which he looked, as may be observed in this engaging admission: "Among psychologists I am known as a chess player . . .; among psychiatrists I am known as an anatomist; among philosophers I am known as a psychologist; and among clinicians as a neuropathologist . . . No man who has stayed within the recognized boundaries of his own field has contributed fundamentally to science."

His varied achievements in neuropathology, psychiatry and philosophy have been ably dealt with by the author, who was once his collaborator in research and always a lifelong friend. Southard's mind was early drawn to etymology and philology, and in his many later exhaustive studies of psychiatric and psychological formulations he employed his early training to classify disease types anew. In the opinion of the reviewer, his resistance to psychoanalytical theories can be traced to an urgent tendency to think of and define people in groups rather than to inspect a single individual in the prolonged, intensive analytical method of Freud. As Dr. Gay has pointed out, Southard strove to be fair as well as cautious in appraising Freud's major hypotheses. From the evidence provided by this book it must be acknowledged that his mind was not one to be easily harnessed to the hour-after-hour contemplation of a patient, often for years, which the psychoanalytical method requires for its therapeutic objective as well as for psychiatric research. He himself admitted a year before he died: "Perhaps it is in definition that I am most interested. Perhaps I believe that the world can get forward most by a clearer and clearer definition of fundamentals. Accordingly, I propose to stick to tasks of nomenclature and terminology, unpopular and ridiculous though they may be. A psychiatric dictionary (to include definitions of every near-lying psychological and philosophical term also) would do more to push mental hygiene on than any other single thing I can think of."

His interest in theories of integration of the personality led him to speculate and to write. To a house physician who asked him to see a patient on the ward, he replied: "Oh, I'm not interested in seeing a patient with that disease. I am writing a book on the subject." To a woman troubled with a disturbing tick or spasm of the face, which she thought might be a handicap in her career, he remarked: "My dear lady, we all have handicaps; my particular handicap is that I cannot make ward rounds." He was intensely interested in the possibility of demonstrating a relation between psychological function and anatomic structure, but it is in the field of pathology of the nervous system that he had his surest footing.

What was most startling about the man was the engaging charm and contagious enthusiasm which he emanated. An incredible number of his associates and pupils would subscribe to what Dr. E. T. F. Richards said of him: "I have not seen his equal in his remarkable ability to stimulate enthusiasm and the spirit of research in others." This subtle alchemy transmuted the interest of many of his friends from clinical practice into research into the unexplored domains of psychiatric medicine. Fortunately, Dr. Gay caught the virus Southard carried about with him and rescued it in a notable contribution to the biography of great personalities in American medicine.

ALVAN L. BARACH

FISH MANAGEMENT

The Improvement of Lakes for Fishing: A Method of Fish Management. By CARL L. HUBBS and R. W. ESCHMEYER. Bulletin No. 2, Institute for Fisheries Research, University of Michigan, Ann Arbor. 233 pp., 74 figs. May, 1938. $1.75.

MARKED increases in the number of anglers in the past two decades without any corresponding expansion of fishable waters have stimulated great interest not only in maintaining fish yields in inland waters but also in projects designed to raise the yields to maximum carrying capacities. For more than half a century, the standard method of aiding fish production was the stocking of lakes and streams with hatchery-reared young fish. In general little or no attention was given to the environmental conditions that obtained in the waters that were stocked until recent years. More and more consideration has been given to various factors that have some influence on fish production in natural waters during the past decade. Up to the present time, such factors as shelter and breeding conditions have been emphasized.

The senior author of this bulletin has been chiefly responsible for the development of devices designed to improve environmental conditions in these respects; he is also responsible for trying these devices out on a large number of Michigan lakes. These experiments and the broad ichthyological knowledge of the authors constitute the fundamental background of the book.

Lake improvement is defined as the creation and maintenance in lakes of conditions which favor the propagation, growth and yield of inland lake fish. The general requirements for the successful production of fish are considered first; these include the physics and chemistry of the water, such as temperature, dissolved oxygen, hardness, depth, spawning conditions, suitable shelter and food supplies. All these subjects are more or less fully discussed, especially with reference to their general bearing on fish production under optimal conditions. The spawning habits of the different species of fish vary widely, for example, and successful reproduction, therefore, depends upon meeting the diverse requirements either naturally or artificially. Food is also a vital factor, so that fish production is substantially proportional to the food supply in the various types of water.

The second, or main, section of the book (pp. 49–201) deals with the construction of brush, log and other artificial structures designed to serve as shelters for fish and their installation in suitable locations. Also the planting of large aquatic plants, which will furnish natural shelters and feeding grounds, is discussed, as well as devices for bettering the spawning conditions. The use of fertilizers is recommended in certain types of lakes for the purpose of increasing the food supply. Methods of aerating the waters of shallow lakes in winter where there is frequently a heavy winter-kill due to the lack of dissolved oxygen are included in this section as well as the control of fish movements, the handling of fish populations showing stunted growth, the removal of excess rough fish, controlling predators and the treatment and prevention of diseases. The final chapter deals with the practicability of lake improvement and its place in fish management. This is followed by an annotated bibliography of 18 pages. The book is a valuable contribution to that phase of aquiculture which is concerned with the production of fish, and it fills a great need in this important field of water utilization.

C. JUDAY

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STATISTICAL TABLES

Statistical Tables for Biological, Agricultural and Medical Research. By R. A. FISHER and F. YATES. London and Edinburgh: Oliver and Boyd. 1938. viii + 90 pp. 12s. 6d net.

THESE tables will be of great value to research workers in the fields indicated and also in several others. Some of them are important for economic and sociological statisticians. The volume will have a wide appeal not only because of the eminence of the authors and the adequacy of the tables for an extensive range of work, but because the paper, type and arrangement have been well chosen to minimize time and eye-strain. The tables presented are:

I. The normal distribution. (Abscissae in terms of areas.) II. Ordinates of the normal distribution. III. Distribution of t. IV. Distribution of χ^2. V. Distribution of z and the variance ratio. VI. The correlation coefficient—values for different levels of significance. VII. The correlation coefficient—transformation of r to z. VIII. Tests of significance for a 2 × 2 contingency table. IX. Probits—transformation of the sigmoid dosage mortality curve to a straight line. X. Probits—simple quantiles of the normal distribution. XI. Probits—weighting coefficients and probit values to be used in adjustments of special accuracy. XII–XIV. The angular transformation. XV. Latin squares. XVI. Complete sets of orthogonal Latin squares. XVII–XIX. Balanced incomplete blocks. XX. Scores for ordinal (or ranked) data. XXI. Sums of squares of these scores. XXII. Initial differences of powers of natural numbers. XXIII. Orthogonal polynomials. XXIV. Calculation of integrals from equally spaced ordinates. XXV. Logarithms. XXVI. Natural logarithms. XXVII. Squares. XXVIII. Square roots. XXIX. Reciprocals. XXX. Factorials. XXXI. Natural sines. XXXII. Natural tangents. XXXIII. Random numbers. XXXIV. Constants, weights and measures, etc.

There is an excellent introduction describing the use of the tables, including some ingenious new uses of old tables, such as that of the χ^2 and variance ratio distributions for obtaining partial sums of the Poisson and binomial series, respectively. Other fruits of the authors' remarkable ingenuity include the work on Latin squares and balanced incomplete blocks in biological experiments, as well as other statistical methods now better known. The section on interpolation at the end of the introduction must be read in order to use the tables efficiently; the methods of interpolation with reference to which several of the tables have been arranged will be novel to most statisticians.

Professor Fisher sends the following erratum. The formula for the range at the top of p. 8 should be

$$1/2PQ = 2/(1-R^2).$$

HAROLD HOTELLING

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SPECIAL ARTICLES

THE TOXICITY AND ABSORPTION OF 2-SULFANILAMIDOPYRIDINE AND ITS SOLUBLE SODIUM SALT[1]

THE discovery of the chemotherapeutic activity of 2-sulfanilamidopyridine in experimental pneumococcus as well as streptococcus infections in mice[2] has led to a trial of the drug in human pneumococcus infections, as well as in various other bacterial diseases. The clinical use of 2-sulfanilamidopyridine was undertaken before a chemical description or any adequate pharmacological and toxicological study of the drug was reported. The only study of the toxicity of the drug is that reported by Wien,[3] who concluded "that this substance has a big advantage over sulfanilamide in being much less toxic," having "about one fourth the toxicity of sulfanilamide."

The above conclusion of Wien has been widely quoted. However, since all Wien's toxicity data were obtained by oral administration of an acacia suspension of the drug and since 2-sulfanilamidopyridine is a rather insoluble substance and is poorly absorbed, considerable doubt exists as to the validity of his conclusion. It has been shown that many sulfanilamide derivatives of low solubility owe their lack of toxicity to poor absorption from the gastro-intestinal tract, and it has been pointed out that determinations of the toxicity of such compounds administered by the oral route may be misleading because of low absorption when large doses are given.[4, 5, 6] Our finding, that when 2-sulfanilamidopyridine is given as its very soluble sodium salt, both the toxicity and the absorption are quite different from that of 2-sulfanilamidopyridine itself, would appear to justify the publication of this preliminary note.

The sodium salt of 2-sulfanilamidopyridine[7] was prepared as follows. One part of sulfanilamidopyridine was suspended in 20 volumes of boiling 95 per cent. alcohol, and 1.5 moles of 1.3 M alcoholic sodium hydroxide were added per mole of sulfanilamidopyridine. The solution was chilled 2 hours in ice, and the white crystalline precipitate filtered, washed with cold alcohol and dried at 110°. Yield, 80 per cent. Titration with standard acid and methyl red showed 98.9 per cent. purity; colorimetric analysis[8] indicated 100.1 per cent. purity. These values were essentially unchanged by recrystallization from 95 per cent. alcohol. In this colorimetric analysis, it is important to note that unless the solution of the sodium salt is treated with the strong trichloroacetic acid solution before dilution, considerably lower (about 8–10 per cent.) results are obtained. On this account, further work was done with the sodium salt to establish its purity. One gram of sodium salt was titrated with standard acid to neutrality using methyl red, the precipitate was filtered off, washed with a small amount of cold water, and dried at 110° for a few minutes and drying completed in a vacuum desiccator. A 97.1 per cent. recovery of the sulfanilamidopyridine resulted, m. p. 190.4–190.9°, unchanged by admixture with a carefully purified sample of the original material. The sodium salt was prepared also by adding sufficient alcohol to completely dissolve the sulfanilamidopyridine, adding alcoholic sodium hydroxide to the solution and immediately cooling. Yield, 71 per cent. A third preparation of the sodium salt was made without the use of alcohol, by dissolving the sulfanilamidopyridine in 1.5 moles of warm 3 M aqueous sodium hydroxide and chilling. Yield, 60 per cent. (A further 20 per cent. yield may be obtained by adding 20 parts of absolute alcohol to the mother liquor). The sodium salts prepared by all three methods appeared to be identical. We have no explanation to offer for the low results which are obtained by the usual colorimetric method.

The sodium salt is a white product, crystallizing from 95 per cent. alcohol in clusters of radiating thin rods. It melts with decomposition at 316.5–317°. Its solubility in the non-aqueous solvents is low, as would be expected of an organic sodium salt. It dissolves in water to the extent of approximately 63 grams per 100 cc (25°). The pH of a 1 per cent. aqueous solution is 10.4; that of a 10 per cent. solution, 11.0.

Acetylsulfanilamidopyridine was prepared by treatment of a warm aqueous solution of the hydrochloride of sulfanilamidopyridine with acetic anhydride, followed by addition of sodium acetate. Recrystallized from 30 per cent. acetic acid, it melted at 225.6–226.3°. Its sodium salt was prepared in boiling alcoholic solution as described above and precipitated by the addition of 250 parts of ether.

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[1] This investigation has been aided by a grant from The John and Mary R. Markle Foundation.

[2] Whitby, *Lancet*, 1: 1210, 1938.

[3] Wien, *Quart. Jour. Pharmacy and Pharmacology*, 11: 1938.

[4] Marshall, Cutting and Emerson, *Jour. Am. Med. Assn.*, 110: 252, 1938.

[5] Marshall, Cutting and Cover, *Bulletin Johns Hopkins Hosp.*, 63: 318, 1938.

[6] Finestone, Bliss, Ott and Long, *Bulletin Johns Hopkins Hosp.*, 62: 565, 1938.

[7] The 2-sulfanilamidopyridine was kindly furnished by Merck and Company and by the Calco Chemical Company.

[8] Sulfanilamidopyridine can be estimated by the same procedure as used for sulfanilamide.[9, 10]

A study was made in mice of the blood concentration-time curves of sulfanilamidopyridine administered orally either as an acacia suspension of the free acid or as a solution of the sodium salt. Blood concentrations were determined by the method previously described for sulfanilamide.[9, 10, 11] Doses of 0.4, 1.0, 3.0, 6.0 and 16.0 grams per kilogram of the acacia suspension yielded blood values of increasing amount, but these values were not at all proportional to the dose. The maximum blood concentrations attained with 6 and 16 grams were around 50 mgm per cent., but in some instances blood levels reached by 6 were greater than those with 16 grams. On the other hand, when the extremely soluble sodium salt was given, it was more readily absorbed, and blood levels attained with doses of 0.4, 1.0 and 2.0 grams[12] per kilogram were roughly proportional to the dose. The maximum blood levels obtained with 1 gram (40 mgm per cent.) were nearly as high as with 16 grams of the suspension, while 2.0 grams gave blood levels of 65 mgm per cent. or over—higher than those obtained with eight times this amount in the form of a suspension of the difficultly soluble acid itself.

When a solution of sodium sulfanilamidopyridine is given to mice *per os*, the toxicity of the substance is greater than that of sulfanilamide. Thus, all in groups of ten mice given 3.0 and 4.0 grams per kilogram died, 60 mice given 2.0 grams gave 50 per cent. mortality, and ten mice given 1.0 gram had severe symptoms but all survived. The symptoms caused by this drug were quite different from those seen after toxic doses of sulfanilamide in that more stimulation and less depression of the nervous system occurred. A rigidity of the tail (the Straub morphine reaction) appeared first, then violent excitement with ataxia, dyspnoea and tetanic convulsions followed by a mixed type occurred. These symptoms appeared in one-quarter hour, and death occurred in less than 4 hours. The blood levels in mice at death have varied from 70 to 94 mgm per cent. (average 83). The administration of an amount of sodium carbonate solution equivalent in base to 4.0 grams per kilogram of sodium sulfanilamidopyridine to mice caused no symptoms. Wien has given the LD_{50} for mice as 16.6 grams per kilogram, a figure about 8 times as great as our value found by using the sodium salt. We have attempted to check Wien's determination of the toxicity of an acacia suspension of the free acid, but due to erratic absorption with large doses and deaths at quite low blood levels, we concluded that the method was worthless and that death may not be the result of the real toxicity of the drug. However, we observed the same symptoms 1 to 3 hours after giving the acacia suspension of the free acid. Wien found that a dog given 1 gram per kilogram of the 2-sulfanilamidopyridine *per os* daily for seven days exhibited no symptoms. We gave a small dog on two occasions a single dose of 1.0 gram per kilogram of the sodium salt, and although a large part of the dose was vomited, the animal showed severe symptoms in the form of tonic and clonic convulsions with occasional opisthotonos. (The maximum blood concentration was 33 mgm per cent.) Another dog given 1.0 gram per kilogram subcutaneously exhibited the same severe symptoms and died with a blood level of 62 mgm per cent.

Blood concentration-time curves and the percenta excretion of the drug in the urine were studied in dogs to which 0.1 gram per kilogram was administered in different ways by mouth. When sulfanilamidopyridine was given without water in gelatin capsules compressed tablets absorption was poor and erra . The administration of water with the drug had e influence on absorption in the case of capsules, but f appear to increase absorption when tablets were us also, when given suspended in acacia or water, abso r tion was more rapid. The greatest, most rapid regular absorption was seen when the drug was gi t dissolved in hydrochloric acid or in sodium bicarbon solution or as the soluble sodium salt.

These observations appear to indicate that fo factors condition the absorption in dogs: (1) t solubility of the preparation, (2) the particle si (3) the state of suspension, and (4) the rapidity passage of the drug from stomach to intestine. Si in the case of patients given tablets of sulfanilami pyridine absorption appears to be erratic,[13] vario methods of administration are being tried on man order to obtain more complete and constant absorptic

Sulfanilamidopyridine is apparently excreted u changed in the urine of the dog, but in the rabbit a man it is excreted partly in the free and partly in conjugated form. In the mouse, only a very sm amount of the drug appears to be conjugated. O of us (B) has isolated the conjugated form from t urine of a patient receiving the drug and found it be p-acetylaminobenzenesulfamidopyridine. Since this substance is even less soluble than the sulfanilamidopyridine and probably less readily absorbed, its sodium salt has been used for toxicity determination in mice

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[9] Marshall, *Jour. Biological Chemistry*, 122: 263, 1937.

[10] Marshall and Litchfield, SCIENCE, 88: 85, 1938.

[11] Marshall and Cutting, *Bulletin Johns Hopkins Hosp.*, 63: 328, 1938.

[12] All values for doses and blood concentrations are expressed in terms of sulfanilamidopyridine.

[13] Long: Personal communication.

Of ten mice given 4.0 grams per kilogram five died; the blood levels in two at death were found to be 77 and 106 mgm per cent. It appears that the acetyl-derivative of sulfanilamidopyridine is of the same order of toxicity as the unconjugated compound if blood concentrations are taken into consideration.

In conclusion, we wish to emphasize that sulfanilamidopyridine on the basis of blood concentration values appears to be more toxic than sulfanilamide. Until more is known about the drug, it should not be used in conditions where sulfanilamide has been shown to be effective.

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THE APPLICATION OF THE NITROGEN ISOTOPE N^{15} FOR THE STUDY OF PROTEIN METABOLISM

The production of nitrogen with an increased concentration of the isotope of atomic weight 15 (N^{15}) by Urey and his collaborators has opened the possibilities of investigating the metabolism of amino acids, proteins and other nitrogenous compounds in normal healthy animals. The principles underlying the procedure are similar to those which have been successfully employed in the investigation of the fate of fats, steroids and other compounds, with deuterium as a tracer. The substance to be investigated is synthesized in the laboratory in such a manner that one of its atoms contains an increased concentration of isotope, in the present case[1] by starting the synthesis with ammonia N^{15}. The rarity and value of the isotopic ammonia compelled the development of methods for amino acid synthesis which should lead to complete recovery of the isotope. The methods employed were modifications of the phthalimide synthesis of Gabriel and of the catalytic reduction of *α*-keto acids in the presence of ammonia according to Knoop. The following isotopic and racemic amino acids are now available for biological investigations, all of which contain nitrogen with more than 2 per cent. N^{15} as compared with the normal abundance of 0.368 per cent.: glycine, alanine, nor-leucine, tyrosine, phenylalanine, glutamic acid, aspartic acid, lysine and leucine. The latter compound also contains, besides the nitrogen isotope, stably (carbon) bound deuterium, and has been resolved in the laboratory into its optical isomers.

The biological application of such substances requires a highly sensitive micro method for the analysis of the N^{15} content in the nitrogen of organic compounds. The only practical procedure requires the use of a mass spectrometer. The nitrogen of the compound is converted to ammonia, elementary nitrogen is liberated from it in a high vacuum system and this admitted to the vacuum tube containing the mass spectrometer proper. In this tube the gas is ionized and under the influence of electric and magnetic fields is dispersed into a spectrum of the component masses. The instrument constructed in our laboratory requires less than 1 mg of nitrogen for an analysis and has a sensitivity of 0.003 per cent. N^{15} when normal nitrogen is analyzed. Any of the amino acids listed above can thus be mixed *in vivo* or *in vitro* with several hundred times its weight of the normal analogue before the analytical methods miss the isotope label.

The concentration of N^{15} in the nitrogen of ordinary casein as well as of ten different natural amino acids was determined and found to be the same as in the nitrogen of air, a finding which indicates that both isotopes of nitrogen are treated indiscriminately in anabolic and catabolic processes.

The nitrogen in organic linkage, as for example in amino acids, is stably bound and does not exchange with the nitrogen of other nitrogenous compounds with which it is brought in contact. This was established by the investigation of ten different systems, each of which contained one normal and one isotopic compound. Whenever, in experiments either *in vivo* or *in vitro*, compounds are observed which contain more than the normal abundance of isotopic nitrogen, the formation of such compounds must therefore be ascribed to chemical reactions.

An investigation on hippuric acid formation has already been reported[2]; other experiments on protein metabolism have now been carried out. The first is concerned with the much discussed question as to whether the animal organism can utilize the nitrogen of dietary ammonia for amino acid formation. Rats were given an ordinary stock diet to which were added benzoic acid and isotopic nitrogen as ammonium citrate. The experimental conditions under which the animals were kept were so chosen that most of the glycine excreted in the urine as hippuric acid was newly formed. This contained a small but significant amount of isotope, indicating that a small part of the glycine had been formed from ammonia nitrogen.

Another experiment carried out with immature rats was still more illuminating. The animals were given a protein-low diet to which isotopic ammonium citrate had been added. After five days they were killed, the carcasses were hydrolyzed and the following compounds were isolated in pure form; glycine, glutamic acid, aspartic acid, proline, histidine, lysine, arginine and creatine. All, with the exception of lysine, contained a small amount of the nitrogen isotope. Both experiments must be taken as proof that at least a small amount of creatine and amino acids can be formed with ammonia as a nitrogen donor and that dietary ammonia may be utilized for this process.

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[1] The authors are highly indebted to Professor H. C. Urey for the valuable gift of nitrogen isotope.

[2] R. Schoenheimer, D. Rittenberg, M. Fox, A. S. Keston and S. Ratner, *Jour. Am. Chem. Soc.*, 59: 1768, 1937.

In another experiment the fate of one dietary amino acid, tyrosine, was followed in a full-grown adult rat kept in nitrogen equilibrium on a normal diet, the protein of which consisted of casein. To this was added an amount of isotopic *dl*-tyrosine corresponding to only 14.4 mg nitrogen addition per day. The animal was kept on this diet for ten days. It excreted an amount of total nitrogen equivalent to that in the total diet, but about half of the isotope was retained by the tissues. The retention must have been accompanied by the liberation (for excretion) of an equivalent amount of nitrogen. The liver and the remaining carcass were worked up separately to locate the isotope. Almost all of it was recovered in the proteins, while the non-protein-nitrogen revealed only traces. Both liver and carcass proteins were hydrolyzed, and pure tyrosine was isolated. The samples contained a high concentration of isotope, indicating an extensive deposition of the dietary tyrosine in the body proteins. However, the isotope content in tyrosine accounted for only about one quarter of the total isotope content in the proteins. Amino acids, other than tyrosine, must thus have taken up nitrogen originally present in tyrosine. This could be proved. The following other amino acids were isolated: arginine, lysine, histidine and the mixture of the dicarboxylic acids, glutamic and aspartic acid. With the exception of lysine, all of them contained a significant amount of isotopic nitrogen. As the dicarboxylic acids contain only 1 nitrogen atom per molecule, the position in the molecule of the newly introduced nitrogen is certain. The position of the isotope in the arginine and histidine, both of which contain more than one nitrogen atom per molecule, had to be investigated. The arginine isolated was split into ornithine and urea. All the isotope was found in urea moiety, while the ornithine contained normal nitrogen. The α-amino group of histidine was removed by converting the amino acid into imidazole lactic acid. The latter contained normal nitrogen; all the isotope must have been in the α-amino group of the original histidine.

The experiment shows that in a normal full-grown and healthy animal, kept on a normal diet, the nitrogen of at least one of the dietary amino acids, tyrosine, is only partly excreted in the urine, while the rest is retained in the protein of the animal, with a corresponding excretion of tissue nitrogen. Only a fraction of the nitrogen deposited remains attached to the original carbon chain of the amino acid, with which it was given, the bulk being utilized in the formation of some other amino acids. Degradation of some of the isolated amino acids has given some insight into the processes which must have been responsible for their formation:

(1) The dicarboxylic acids containing only one nitrogen atom were either newly synthesized from substances with different carbon chains or underwent deamination followed by amination of the remaining keto acid. Whichever of these two processes was responsible, its occurrence was not suppressed by the abundance of these substances in the dietary protein, casein.

(2) Arginine was formed from ornithine, probably in the course of urea formation, according to the theory of Krebs.

(3) Histidine was successively deaminated and reaminated at the α-carbon atom alone.

(4) Ornithine and lysine are apparently not subject to such processes.

All these reactions had occurred with constituents of the proteins of a normal animal and reveal an extens chemical activity of its proteins.

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BOOKS RECEIVED

Brooklyn Botanic Garden Record; Vol. XXVII, No. July, 1938; Contents: Botanic Gardens of the Wor Materials for a History. Second edition. Pp. 1 406. Brooklyn Institute of Arts and Sciences. $2.

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INTUITION, REASON AND FAITH IN SCIENCE[1]

By Professor GEORGE D. BIRKHOFF
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FROM the earliest times scientific ideas even when crudely conceived have been of immeasurable importance, not only for man's material advancement and control over nature, but also in modifying and expanding his philosophic and religious outlook. In the effort to obtain a better understanding of his place in the cosmos, he is compelled to proceed largely by considerations of analogy based upon supposed or actual fact. And so he turns more and more toward the ever-widening vistas suggested by science in its continual discoveries of new truth.

To-day the significance of science as a principal source of revelation is almost universally recognized. Thus recently, on behalf of Pope Pius XI, Cardinal Pacelli spoke before the Pontifical Academy of Sciences concerning the enlightenment that comes from "the potent streams of the natural and rational sciences and the great river of revealed wisdom."[2] He said that the former are found "wherever man looks for and finds truth." As for "the great river of revealed wisdom," is it not to be found in all the absolutely sincere utterances of poets, philosophers and prophets, based on the relevant knowledge of their day and made after deepest meditation? It would seem that such utterances are in essence similar to the pronouncements of the scientist. Is not the vague, prophetic conjecture of Pythagoras that nature is mathematical as true as Newton's more precise law of gravitation? From this point of view, the great streams of revelation seem to merge insensibly into one.

Nevertheless, the immediate effect of scientific advances is often very disquieting. The strong opposition long shown to the Darwinian theory of evolution bears witness to this fact. Similarly at the present day the ever-increasing number of uncoordinated theories and mechanical inventions confuses and chills many of us. Man is felt to be a mere tragic detail in a vast incomprehensible whole, and our old sense of values seems to become less and less real.

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[1] Address of the president of the American Association for the Advancement of Science, Richmond, Va., December 27, 1938.

[2] See SCIENCE, 86: 2238, 470–472, November 19, 1937.

To persist in such an attitude of discouragement is unjustified. Every individual has implanted within him the desire to understand his rôle in the existing order. He feels an inalienable right to find out his duties and privileges as a citizen of the universe. By the light of any new knowledge he is always certain to gain deeper insight into his position. The wise advice of our own great Emerson comes to mind: "Fear not the new generalization. Does the fact look crass and material, threatening to degrade thy theory of spirit? Resist it not: it goes to refine and raise thy theory of matter just as much."

What, then, are some of the larger points of view which are suggested by science to-day? In attempting a reply I can of course only offer a personal interpretation, inevitably reflecting the fact that I speak as a mathematician having some acquaintance with physics.

Let us observe in the first place that the universe presents antipodal aspects—the objective and the subjective, the impersonal and the personal. If we take the objective aspect as more fundamental we put our emphasis on the notion of reality; and if we start from the subjective, we prefer to speak of knowledge. In either case we are able to discern a kind of nature-mind spectrum; for there appears a roughly given hierarchy of five ascending levels—mathematical, physical, biological, psychological and social. Each level has its appropriate special language. The basic corresponding concepts are respectively: *number* at the mathematical level; *matter* at the physical level; *organism* at the biological level; *mind* at the psychological level; and *society* at the social level. If we choose to select one of these as somehow more real than the others, a great distortion arises in our point of view. For instance, if we regard the physical level as the most fundamental, we become materialists. But why make such an unnecessary choice? The languages of the various levels are essentially independent of one another, and the observed laws are best expressed in their own natural terms. Why mix up the levels of knowledge unnaturally? Does it clarify our idea of social justice to try to explain it in terms of the reactions between protons and electrons in the brain?

These considerations bring us to a first general point of view towards the levels of knowledge: It is desirable to accord reality in equal measure to all kinds of knowledge everywhere, and so to view the universe as broadly and impartially as possible.

Another very important observation is that in order to understand the various facts and their interrelations we must always use abstractions, that is, conceptual tools of a logical or mathematical nature. Contrary to opinions which prevailed until recently, any abstraction serves only limited specific ends. At best it will enable us to grasp more clearly some small fragment of reality. For example, by use of the abstraction of Euclidian geometry, and in that way alone, we understand the nature of space with a considerable degree of exactitude; and yet to-day scarcely any physicist would ascribe objective reality to space in itself. It has been Einstein more than any one else who has taught the scientific world the true rôle of Euclidian geometry by means of his theories of space-time and relativity. More generally, we have come to realize that our only approach to a better understanding of the world is by means of a widening succession of abstract ideas, each explaining imperfectly some aspect of the stupendous whole. This is a second synthesis deserving of especial emphasis.

Thirdly, I would state a fundamental truth about the social level, which in some sense is the highest level of all: The transcendent importance of love and good-will in all human relationships is shown by their mighty beneficent effect upon the individual and upon society.

Thus I have begun by presenting very briefly three important articles of my personal faith. These are not verifiable experimentally or strictly demonstrable, so that any one is free to agree or to disagree. Against my belief that the levels of knowledge are to be taken as equally real, one may set for instance an opposing belief that every fact is ultimately expressible in purely physical terms. If my position is natural for the mathematician with his abstract point of view, the other may be preferred by the tough-minded physicist, the biologist with mechanistic inclinations and the psychologist with a behavioristic outlook. The future will probably show that both of these beliefs are partly true and partly false.

Similarly, against my conviction that any particular abstraction is merely a useful tool enabling us to understand certain facts, some will contend that one particular abstraction will prove to be final and absolute. Here my attitude springs from an extensive acquaintance with mathematical abstractions and their numerous applications, whereas the theoretical physicist, for example, tends to believe that the ultimate theory of atomic structure is soon to be obtained.

Likewise some will declare that, much more than love and good-will, it is devoted loyalty to the state which is important; and I can imagine that under certain conditions such an assertion might be justified.

It is my especial purpose to show how this phenomenon of faith arises inevitably in the mind of the scientist whenever he tries to evaluate technical conclusions in his special field. In doing so I shall discuss the role of intuition, reason and faith in science, first at the mathematical and physical levels, and then more briefly at the biological, psychological and social levels. This will lead me in conclusion to formulate two other items of my personal creed in the hope that they may be worthy of your attention.

By way of definition it must be indicated first what is meant by intuition. There are certain elementary notions and concepts which come spontaneously to the minds of all who observe, experiment with and reflect on a specified range of phenomena. Such generally accepted ideas or intuitions constitute the consensus of reaction of intelligent men to a definite part of the world of fact. John Stuart Mill has said, "The truths known by intuition are the original premises from which all others are inferred." It is in this sense that I shall refer to intuition. By reason I shall mean the rational superstructures which may be erected upon the basic intuitive ideas by means of deductive or inductive reasoning. These superstructures will so be accepted by all who are able to follow the sequence of logical steps involved. By faith I shall mean those heuristically valuable, more general points of view, which are beyond reason, and sometimes in apparent contradiction with one another, but which to the individual concerned seem of supreme importance as he *endeavors to give his conclusions* the widest possible scope.

It is clear that in this way we obtain a basic classification of knowledge into three easily distinguishable types. Let us consider the occurrence of these types at the various levels of knowledge.

By continual crude experimentation with classes of discrete objects, man has come gradually and inevitably into the possession of certain numerical ideas. In particular he has been led to think of the positive integral numbers 1, 2, 3 . . . as entities which exist in almost the same sense as the objects themselves. This concept finds its realization in the designation of the integers by corresponding marks 1, 2, 3 . . . Such integers are found to be subject to certain simple arithmetic laws, and these laws are regarded as intuitively true.

The integers form the basis of a great part of mathematics. For it is found that with their aid one may construct fractions and, more generally, real and imaginary numbers. In the course of the centuries mathematicians have thus built by processes of pure reason the elaborate structures of algebra, the theory of numbers and analysis. An extensive array of beautiful and useful theorems has been deduced.

Similarly in geometry—which in its origin may be regarded as the most elementary branch of physics—we experiment with rigid material objects and arrive readily at the notions of idealized small rigid bodies or "points" and of idealized "lines" and "planes." Then we observe that certain postulates hold, such as the familiar ones of Euclid. By means of these postulates, which embody our intuitions, we are able by deductive reasoning to arrive at other geometrical theorems, including such results as the celebrated Pythagorean theorem which shows us in particular that a right triangle with legs of 3 units and 4 units in length has a hypotenuse of exactly 5 units in length. The vast mathematical domain called "geometry" has arisen from these elementary geometrical facts as a primary source.

There are many other abstract mathematical structures besides those just alluded to. In all cases it is found that they are made up of certain accepted *intuitions (or postulates) and their logical consequences.*

Now what I desire particularly to point out is that the mathematician goes far beyond such generally accepted clean-cut assumptions and conclusions, in that he holds certain tacit beliefs and attitudes which scarcely ever find their way into the printed page. Yet these form none the less part of a considerable oral tradition. For instance, he believes in the existence of various infinite classes such as that made up of all the integers. He believes also that the whole *body of strict logical thought called mathematics is* self-consistent: in particular when he finds that the number π admits of diverse forms of expression, as, for example,

$$\pi = 4\left[\tfrac{1}{1} - \tfrac{1}{3} + \tfrac{1}{5} - \tfrac{1}{7} + \ldots\right]$$

and

$$\pi = 2\sqrt{3}\left(\tfrac{1}{1}\,\tfrac{1}{1} - \tfrac{1}{3}\,\tfrac{1}{3} + \tfrac{1}{5}\,\tfrac{1}{9} - \ldots\right)$$

he feels absolutely certain that if the unending calculations could be fully carried out, the results would be exactly the same in all cases. Furthermore, when he recalls that in the past the most difficult mathematical questions have been ultimately answered, he is inclined to believe with the great German mathematician, Hilbert, that every mathematical fact is provable. Besides all this, he attributes certain values to his results and their mathematical demonstrations: some theories seem important; some proofs are regarded as elegant, others as profound or original, etc.

Such somewhat vague ideas illustrate what I would call mathematical faith. Nearly all the greatest mathematicians have been led to take points of view falling in this broad category, and have attached the deepest significance to them.

What I wish to emphasize concerning this generally overlooked aspect of mathematical thought is that, on the one hand, the beliefs involved have been of the utmost heuristic importance as instruments of discovery, and, on the other hand, when examined in detail they generally turn out to involve ideas which are held true or false, according to the specific definitions which may be subsequently adopted.

Suppose, for instance, that we turn to the first question of the existence of infinite classes. There was no hesitation about the unconditional acceptance of such classes until within a few decades, although a few, like the ancient Greek philosopher Zeno and the German algebraist Kronecker, profoundly distrusted the use of the infinite in mathematical reasoning. To-day, however, due primarily to the theory of transfinite aggregates created by Georg Cantor about fifty years ago, mathematicians have come to realize that such an infinite class may exist in the so-called "idealistic" sense but not in the sense of explicit constructibility. Thus the class of all collections of positive numbers less than 1 exists in the idealistic sense, but not in the alternative, more concrete sense.

A similar situation has arisen in the detailed study of the self-consistency of mathematics. It has appeared that very limited parts of mathematics can be proved self-consistent. But such a general assertion as that "the whole of mathematics is self-consistent" would be considered to-day not to be sufficiently precise; and each time that the proof of self-consistency is extended further, a definite logical price has to be paid in that certain so-called metamathematical ideas are tacitly employed, which need themselves to be investigated in the same respect. For instance, work prior to the "Principia Mathematica" by Whitehead and Russell (1910) showed that if the notion of class was not restricted, certain logical paradoxes would inevitably result. For this reason a theory of the "hierarchy of types" was devised by them, which limited the notion of class and so avoided the apparent inconsistencies. We are thus entitled either to say that mathematics as of the year 1900 was self-consistent or was not, according to the point of view which is adopted. In any case the belief in question has led us to a much deeper insight into the nature of logic.

With regard to the unlimited power of mathematical demonstration, it has been recently proved by the Austrian mathematician Gödel that, if we restrict ourselves to reasoning of an ordinary type, there exist explicit "undecidable" theorems, while from a higher metamathematical point of view such a theorem might be demonstrable. Hence Hilbert's affirmation is in one sense false. But despite this fact the open question on which he focused attention is much better understood than ever before.

Likewise in the question of value in mathematics, such as the importance of theories, or the elegance, profundity and originality of proofs, it is clear that these obscure ideas depend in large measure upon the momentary state of the science. Thus the theory of functions of an imaginary variable and classical geometry were regarded as extremely important a quarter of a century ago; while to-day the theory of functions of real variables and the basic kind of geometry called analysis situs have respectively displaced these subjects in general mathematical esteem. It would be hard to explain adequately the reasons for this change, but the increasing role of discontinuous quantity in physical theory and the relativistic point of view towards space and time have certainly been contributing factors.

An excellent instance of the power of individual mathematical faith in bringing about creative advance has been afforded by an American mathematician, the late Eliakim Hastings Moore, past president of this Association. Moore was a thorough-going abst tionist who believed that mathematics itself shoul reorganized from a still higher point of view, by dissection of essential common parts out of appa ently different abstract fields. His point of view w strongly confirmed by the analytic work of Hilb and Erhardt Schmidt near the beginning of this tury. And so Moore was led to create his "Gene Analysis" in 1906. This aimed to embody his con tion that "The existence of analogies between central features of various theories implies the e tence of a general theory which underlies the ticular theories, and unifies them with respect to th central features."

As time has elapsed, the deep truth of Moore's c tention has been amply sustained. Indeed one of most active schools of contemporaneous mathemati thought follows the higher abstract point of vi adopted by Moore. But it has been found necess to modify Moore's program, in that, instead of a sing "General Analysis" serving as an *omnium gatheru* it has been desirable to employ a few typical form In this way his faith in the power of higher abstr tion has been largely and yet not fully justified.

A good many mathematicians are seriously ha pered by lack of the ardent positive faith which Mo showed. This type of deficiency is generally due to strong development of purely critical powers ar over-specialization. Several times I have observ this lack in myself, only to be counteracted by defini effort. For example, I did not make active use of t fundamental integral of Lebesgue for a long time, an so was prevented from pursuing to their natural co clusion certain ideas which finally led me to establis the basic "ergodic theorem" in 1931. Here I was finally converted, as it were, to the use of this tool by the important advances of Koopman and von Ne mann, and in particular by the latter's proof of the "mean ergodic theorem." It is worthy of note that the related ergodic hypothesis goes back in its origins to the physicists Boltzmann and Maxwell.

Let us turn next to the physical level where the corresponding situation is at least equally interesting.

If we accept the ordinary conceptions of space and time, which seem destined always to play a basic role in workaday physics, we find that the simplest physical *ideas are those which arise through the manipulation* of massive bodies. As these ideas have become clarified, they have been given abstract formulation in terms of such concepts as those of mass, force, etc. Newton's celebrated three fundamental laws of motion embody the final form of the refined intuitions thus arrived at. With these as a basis and the acceptance of certain further special observed laws, one may deduce by mathematical reasoning the theory of mechanics as applied, for example, in the solar system.

milarly, through experimentation with electrified es, electric currents, magnets, etc., there was de- oped by Faraday *the intuitive ideas of electric and* gnetic lines of force which are now generally epted. Later Maxwell incorporated these ideas in appropriate electro-magnetic equations. Upon basis all classical electro-magnetic theory has been ally constructed. Furthermore, by means of the *tification of the light wave and the electro-mag-* wave, due to Maxwell, an adequate theory of light been obtained.

hus we see the important role which intuition and on have played in two fundamental branches of sics—mechanics and electro-magnetism. A cursory vey of the various other branches of the subject ld show that a similar situation holds throughout, pt in the rapid developments of quantum mechan- during the last decade or so. In this strange ry the physicist begins indeed with a planetary del of the atom, reminiscent of Niels Bohr's earlier ory. But *a flying leap is made from this temporary* ffolding to what is thenceforth regarded as the only ic reality—the wave equations of Schrödinger and, tter still, of Dirac. Once having arrived at these thematical equations the physical theorist proceeds show how he can predict innumerable facts previ- ly out of his range by use of this arbitrary *ad hoc* chinery. The process involved somehow reminds of a record sea voyage made through a fog! I not but anticipate that a more intuitive and tural approach to essentially the same results will found later on. An analogous earlier instance in ysics is perhaps to be found in the unmotivated ory of cycles and epicycles entertained by the cient astronomers. This explained the motions of e heavenly bodies with considerable success, but was destined to be completely displaced by the intuitively reasonable, gravitational theory of Newton.

The fact remains, however, that the recent development of quantum mechanics forms one of the most astounding and important chapters of all theoretical physics.

It is interesting to recall how this great advance came about through the faith of the German physicist Planck at the outset of the present century. His direct experience with the phenomena of radiation had led him to believe that there were discontinuous processes at work, not to be explained by any modification of the time-worn classical theories, and so he was led to formulate his celebrated quantum hypothesis in 1900. It was this daring concept of Planck, more than anything else, that has freed the minds of physicists from the shackles of too conventional thinking about atomic phenomena, and so has made possible the quantum-mechanical quest of which the end is not yet in sight.

There has always been an abundance of faith among the physicists. Every one knows how Newton and others have found confirmation even for their religious beliefs in the lawful character of physical phenomena. It is not hard to understand why the tendency towards dogmatic affirmation among the physicists has been stronger than among the mathematicians. For the physicist with considerable justice feels that he is exploring the mysteries of the only actual and very exciting universe; whereas the mathematician often appears to live in a purely mental world of his own artificial construction. A good illustration of this tendency of the physicists is afforded by their changing attitudes towards the wave theory versus the corpuscular theory of light. Over a considerable period the corpuscular theory of Newton held sway; then this was displaced by the wave theory of Huyghens, the Dutch physicist; and nowadays a kind of vague, uncertain union of the two is generally accepted.

In this connection it is especially interesting to recall the scientific beliefs to which Faraday was led in his fundamental work on electricity and magnetism. From his experimental results in this field, he saw that there was obeyed here as elsewhere the law which he called the "conservation of force" and which we today would call the "conservation of energy." He saw that this energy was localized in space, and he could only conceive of it as being propagated in time; and so he was led to the belief that electro-magnetic energy is also propagated with finite velocity. Thus in an article, "On the Conservation of Force," published in 1857, he expressed himself as follows: "The progress of the strict science of modern times has tended more and more to produce the conviction that 'force [energy] can neither be created or destroyed' . . .;"

"*time* is growing up daily into importance as an element in the exercise of force; to inquire, therefore, whether power acting either at sensible or insensible distances, always acts in *time* is not to be metaphysical." By way of justification of the rather mathematical direction in these thoughts, Faraday said further, "I do not perceive that a mathematical mind, simply as such, has any advantage over an equally acute mind not mathematical . . .;" "it could not of itself discover dynamical electricity nor electro-magnetism nor even magneto-electricity, or even suggest them." But the achievements of the more mathematical Maxwell were later to show that Faraday had underestimated the power of pure reason.

It is thus clear that through an act of faith Faraday attained to a kind of deeper insight; for the existence of the electro-magnetic wave has long since been established experimentally. However, the beliefs of Faraday in this connection can not be regarded as absolutely true, since according to present-day conceptions the notion of energy which he accepted is only roughly valid as a statistical approximation. Nevertheless, Faraday certainly penetrated more into the nature of electrical and magnetic phenomena than any of his contemporaries; and it is difficult to see how, with the limited mathematical and physical knowledge at his disposal, he could have gone any further in the way of prophetic conjecture.

The intimate relation between philosophical-scientific points of view and actual advances in theoretical physics has been admirably illustrated by Einstein's gravitational theory of 1915. Taking as his starting point the bold but reasonable hypotheses that matter must condition space and time, and that, in parts of space remote from matter, elementary particles move with uniform velocity in a straight line, he arrived at his field equations as the most elegant mathematical embodiment of these ideas. Thus there was obtained a quasi-geometrical theory of gravitation which in certain respects is more natural than the celebrated theory of Newton, while the predicted differences, although excessively minute, are in favor of the new theory. But Einstein's theory can not be regarded as true in any absolute sense, since it gives us at best a partial, highly idealized view of the physical universe.

It is hardly too much to say that, since the beginning of the present century, the main advances in theoretical physics have been the outcome of a similar kind of mathematical guesswork, in which, however, the mathematician himself has taken little or no part! The guessing of the physical theorist is guided almost entirely by considerations of subtle mathematical analogy.

This peculiar situation has led naturally enough to the feeling that pure mathematics almost suffices without much recourse to the results obtained in the physical laboratory. Sir Arthur Eddington has embodied the extreme point of view in his recent book, "The Relativity Theory of Protons and Electrons," thus taking a position antipodal to that of Faraday. Eddington says: "Unless the structure of the nucleus has a surprise in store for us, the conclusion seems plain—there is nothing in the whole system of laws of physics that can not be deduced unambiguously from epistemological considerations. An intelligence, unacquainted with our universe but acquainted with the system of thought by which the human mind interprets to itself the content of its sensory experience, should be able to attain all the knowledge of physics that we have attained by experiment. . . . For example, he would infer the existence and properties of radium, but not the dimensions of the earth."

I would comment upon this mystical conjecture of Eddington as follows: It is no doubt partially tr that in some respects we need the laboratory less t we did before, due to the fact that we live surrou by all manner of scientific instruments and ma with whose properties we have become acquai In other words, we live in a transformed world is a kind of huge laboratory. Yet I doubt wheth individual, however intelligent, who was not acq with such instruments and machines, would be through analysis of ordinary sensory experien go very far. On the other hand, I would agre Eddington that the starting point from which k physical laws may be deduced is likely to depe only a few intuitive ideas; and perhaps a sufficie powerful mathematical intelligence would realize t the facts of sensory experience could only be sim explained in this way.

An equally remarkable conjecture was expressed Dr. Charles Darwin in a vice-presidential add "Logic and Probability in Physics," before the Br Association last summer. In this address he said, "T new physics has definitely shown that nature has sharp edges, and if there is a slight fuzziness inher in absolutely all the facts of the world, then we mu be wrong if we attempt to draw a picture in ha outline. In the old days it looked as if the world h hard outlines, and the old logic was the appropri machinery for its discussion." He therefore sugges "that some day a real synthesis of logic will be mad leading to "a new reformed principle of reasoning."

Here I can agree with Darwin to the extent admitting that there always exists a metamathematic fringe in logic. But it seems obvious that in logi there has been a record of continual advance by critica and profound diversification rather than by any essential alteration of point of view.

In my own limited experience in mathematic physics I have also seen how natural it is to take a positive attitude on open questions. Thus a good many years ago I showed mathematically that mere spatial symmetry about a center necessitates a *static* gravitational field. This led me to believe that the Einstein field equations were probably too inelastic to fit the facts, but I did not put forth this opinion. Shortly afterwards Lemâitre, in trying to explain the expanding (non-static) stellar universe found it necessary to modify the field equations, in part because of my result; and so my belief was to this extent justified.

Again, I have had during the last few years a feeling that a conceptual space-time model for quantum mechanics is likely to be found, although theoretical physicists would in general disagree. Nevertheless, my faith is so strong that my recent researches lie principally in this direction. I have already found interesting results, and am confident that these efforts will *not* be wasted, since the possibilities of the conptual approach need to be more carefully explored.

In ending these remarks about the role of intuition, eason, and particularly of faith, at the physical level, is to be observed that the physicist as such sysnatically ignores the phenomena of life, for it is d and not living matter with which he concerns imself in his laboratory.

All in all, it is a faith in the uniformity of nature hich remains the guiding star of the physicist just for the mathematician it is a faith in the self-constency of all mathematical abstractions, although these faiths are more sophisticated than ever before. The minds of both are tinged with an unwavering belief in the supreme importance of their own fields. The mathematician affirms with Descartes, *omnia apud me mathematica fiunt*—with me everything turns into mathematics; by this he means that all permanent forms of thought are mathematical. The physicist on his part is apt to think that there is no reality essentially other than physical reality, so that life itself is finally to be fully described in physical terms.

Although I have no especial acquaintance with the biological, psychological or social domains, it seems clear to me that a similar situation prevails in them. In the biological field the intuitions upon which one depends are those associated with the concept of the organism and its evolution. These intuitions can not be formulated conclusively and completely in simple postulates, as is possible at the mathematical and physical levels. It is rather through an acquaintance with an immense array of interrelated, analogous facts that the biologist finds himself able to deal with novel situations. By means of the geological record on the one hand and the results obtained in the field and laboratory on the other, he acquires a better and better understanding. His principal weapon is always inductive reasoning. It seems certain that a deductive treatment of biology is at least very remote and if ever accomplished will be utterly different from anything which we can imagine to-day. There are, however, a few special fields like the theory of heredity, in which a considerable mathematical structure has been developed. In this theory, by means of the "chromosomes" and their corresponding abstract "genes," it has been possible to explain a complicated array of facts.

The faith of the biologist generally tends in the direction of a mechanistic theory of life or of some opposing vitalistic theory. In fact, he is forced to employ the principle of physical causation in his efforts to understand biological phenomena and does not yet know of definite limitations in its use. Recently there has been some indication of a return to vitalism, so that once more a considerable group of biologists are convinced that not all the phenomena of living matter are to be accounted for by ordinary physical and chemical law. The controversy involved has long been a burning one, and accordingly one naturally suspects that the question is really meaningless. In any case, however, special mechanistic hypotheses have so far pointed the way to new creative advances.

It is interesting to remark that the insufficiency of a rigorously deterministic theory of the living organism admits almost of mathematical demonstration in the following manner. A genuinely mechanistic universe would have to be free of any infinite factors. For example, if one accepts a simple Newtonian theory, there might be reaching the earth from infinite space unknown quantities of matter and energy, so as to change arbitrarily the course of events upon the earth. But in any completely mechanistic system, free of such infinite factors, it is not difficult to prove that there will necessarily be a kind of eternal Nietzchean recurrence. For instance, we are here together this evening considering a particular topic. The strict adherence to the deterministic point of view would entail the consequence that in the eons yet to come this same scene will be re-enacted infinitely often. I submit that this is dramatically improbable!

Recent advances in the chemical knowledge of large organic molecules seem to indicate an innate hospitality of actual matter toward the evolution of the living organism. In this way a plausible genetic account of the origin of life is suggested, which, however, can scarcely be called mechanistic. It begins to seem possible that we are on the verge of further refinements in our concept of matter, such as Emerson anticipated in the quotation made above.

The situation at the psychological level is even less amenable to precise treatment. All of us have a life-long experience with ourselves and other human beings. This automatically gives rise to a vast complex of intuitive psychological notions. We all are aware of course that there are concomitant physiological processes going on in the body, nervous system and brain. Now it is the business of the professional psychologist to give exact definition and interpretation to these crude ideas; and he finds his greatest illumination in the facts of abnormal psychology, with which most of us are unacquainted. However, in the case of either layman or professional the processes of reasoning are mainly by analogy. Even the psychiatrist, familiar with many concrete cases, must treat each new patient by the inductive method. There are too many psychological intuitions and too few exact laws for any imposing edifice of pure reason to be erected.

In certain restricted psychological domains, formalization is to some extent possible. Thus I have ventured to formulate a theory of "esthetic measure," by explicit numeration and weighting of esthetic factors. This aims to explain certain simple esthetic facts in our enjoyment of visual and auditory forms. The theory has been to some extent substantiated by experiments made at Harvard and elsewhere. But in any case, no matter how successful the theory might prove, it would be wholly absurd to try to set up an elaborate logical structure on the basis of the fairly arbitrary and inexact assumptions involved. Generally speaking, as we proceed from the more objective to the more subjective levels of thought, we find that elaborate logical structures seem to be of less and less utility.

The basic belief of the professional psychologist is in the completeness of the physiological accompaniment of every psychical fact; and he formalizes the observed facts by means of the parallelism. But there is a conflict between this attitude of the technician towards mind, for whom the individual is a complex of neurally characterized components, and that of the ordinary man—equally an expert though of a different kind—who sees all sorts of permanent values in personality, not adequately characterized in neural terms. The second attitude leads nearly all of us to have deep affections and abiding personal loyalties, whether or not we are psychologists!

Here again I think that these apparently opposing points of view are both more or less true; and I incline all the more to this opinion because of my conviction that as yet we know relatively little about the phenomena of personality. For it seems certain to me that the extent of hidden organization in our universe is infinite, outside as well as inside of space and time; such a conviction is very natural to a mathematician, since the three ordinary spatial dimensions and the single temporal dimension are for him only particular instances of infinitely many other conceivable dimensions! If this be true, any broad conclusions concerning the nature of personality would seem altogether premature.

At the social level the most serviceable intuitive ideas cluster around the concept of societal evolution. It is of course the comparative study of human institutions which furnishes the principal interest. The analogy between forms of society and evolving org isms is a deep-lying one. Here again the use logical structure which can be built around the ve complicated facts is exceedingly simple. Even i such a formalized field as ethics, dealing with tl behavior of the individual as a member of societ logic plays an almost negligible role.

Belief here seems to gather principally around t idea of societal progress. Progress—or its non-existence—serves as our fundamental tenet. Some believ that society can improve indefinitely, tending towar a perfect society. Such a belief is of course a fund mental one in most religious systems. Others fi this idea too naive. They stress the gregarious insti in man and tend to think of societal changes as taki place in various directions strongly conditioned changing physical environment. All would adm however, that without the concept of dynamical soc processes, social theorizing would be stale and u profitable.

Let us turn now to consider some further conc sions, towards which this brief survey of intuition reason and faith at the various levels seems to point

As far as intuition and reason are concerned, these are the common property of all competent individuals. The narrow, closely articulated chains of deductive reasoning serviceable at the earlier levels are more and more replaced by loose webs of inductive reasoning at the later levels, as we pass from the objective to the subjective. At the same time the basic intuitions change from the simple and precise types employed in mathematics and physics to the increasingly complicated and diverse forms characteristic of biological, psychological and social phenomena.

However, it is just as necessary to clarify and to formalize our knowledge at these later levels as at the earlier ones. The processes of systematic reasoning, whether inductive or deductive, have always a definite prophylactic value, and in particular enable us to avoid the dangers of prejudiced and intolerant points of view. It may be observed in passing that the careful application of impartial thoroughgoing analysis is as important for everyday living as it is in the study and the laboratory.

The striving for rational comprehension is one of the noblest attributes of man. In his agelong difficult struggle he has been able to secure greater freedom only through a better technical mastery of his environment. No other method of liberation has been vouchsafed to him. But this increased mastery has brought with it automatically new intellectual responsibilities and a more complex way of life. In consequence, unforeseen and threatening dangers arise from time to time; *and there is thus imposed on him the necessity* advance still further, which is to-day more urgent an ever before.

A new injunction has been laid upon the spirit of an, to know and to understand ever more broadly nd deeply.[3]

Now along with the increase in scientific knowledge ere appear certain crudely expressed, deeper insights, not completely true or false, some in opposition to others, but all supremely valuable nevertheless. These are embodied in beliefs which seem the inevitble accompaniment of all creative thought.

Thus in the daring effort of the scientist to extend owledge as far as possible, there arises an aura of ith. It is this spontaneous faith which furnishes the ost powerful incentive and is the best guide to rther progress.

Such are some of the very general points of view which a considerable mathematical and scientific experience has led me. If they are worthy of serious attention it is not because of their novelty, but rather because in their aggregate they rise above the details of the numerous specialized fields of knowledge and sustain the scientist in his unceasing and ardent search after truth.

Doubtless many of you are ready to ask the ever more insistent question: If science has thus profoundly modified the general outlook and way of life of mankind, is it not the especial duty of such an association as ours to point out constructive remedies for the ensuing maladjustments? In the "Part II: Science and Warfare" of his admirable address as president of the British Association last August Lord Rayleigh closed by expressing the hope that our two associations could cooperate in such a way as to "bear useful if modest fruit in promoting international amity." In this hope all of us will deeply concur. The presence of Sir Richard Gregory with us at the Richmond meeting is the first token of the projected closer relation between the parent British Association and ourselves. It is much to be desired that this action will encourage further unification of the whole scientific world. I am sure that practically all our joint membership would agree with me that it is the wider diffusion of "the steady light of scientific truth" which holds out most hope of a better understanding among men.

SCIENTIFIC EVENTS

THE PENNSYLVANIA CHEMICAL SOCIETY

A GROUP of Pennsylvania chemists received on December 14 a charter as "The Pennsylvania Chemical Society." Included among the incorporators are Dr. Edward R. Weidlein, director of the Mellon Institute at Pittsburgh, and Dr. Frank C. Whitmore, dean of the School of Chemistry and Physics at the Pennsylvania State College.

The society is incorporated "for the purpose of encouraging in the broadest and most liberal manner the advancement of chemistry as a science and as a profession in the Commonwealth of Pennsylvania, especially in fostering public welfare and education in matters involving chemistry, and aiding the development of industry and promoting the health, happiness and prosperity of the people of the Commonwealth. The society will carry forward the important role which chemistry has played in Pennsylvania from earliest Colonial times. Even prior to the establishment of this nation when the colonies and the early states were mainly dependent upon other foreign countries for many advances in science and also for most of their chemical necessities, there was formed in Pennsylvania what appears to be probably the first organization on the American Continent for the production of chemical products upon an industrial basis. Pennsylvania has mothered American chemical industry and been the seat of much distinguished work in the profession. Pennsylvania has led in the formation of institutions of learning from which there have gone forth innumerable chemists to teach others throughout the land how best to make use of the science and how to serve the commonwealth, the nation and themselves in an adequate capacity."

The officers of the society are as follows:

President—Dr. Jos. W. E. Harrisson, consulting chemist, member of the firm of LaWall and Harrisson of Philadelphia, assistant professor at the Philadelphia College of Pharmacy and Science.

Vice-president—Dr. Nelson W. Taylor, of the School of Mineral Industries, Pennsylvania State College.

Secretary and Treasurer—Dr. Elliott P. Barrett, member of the staff of the Mellon Institute for Industrial Research, Pittsburgh.

The society will shortly hold a meeting for formal acceptance of the articles of incorporation and will actively proceed with its corporate purposes.

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[3] From my circular Association letter of 1936.

OFFICERS OF THE AMERICAN CHEMICAL SOCIETY

Dr. Samuel Colville Lind, dean of the Institute of Technology of the University of Minnesota, has been elected president of the American Chemical Society for 1940. Dr. Lind will take office as president-elect on January 1, 1939, at which time Professor Charles A. Kraus, of Brown University, becomes president, succeeding Dean Frank C. Whitmore, of Pennsylvania State College.

The new president-elect was chosen by the council from four nominees receiving the largest number of votes in a national poll by mail by more than 22,000 members of the society. The council includes national officers, directors, editors of publications, past presidents, chairmen of professional divisions and councilors of the eighty-five local sections.

Dr. Lind, who has been editor of the *Journal of Physical Chemistry* since 1933, has been a leader of chemical research in the field of radioactivity, radium extraction and measurement, influence of radiation on chemical action, kinetics and chemical reactions, photochemistry and chemical effects in electrical discharge. He originated the ionization theory of the chemical effects of radium rays and invented the Lind interchangeable electroscope of radium measurements.

He taught at the Massachusetts Institute of Technology in 1902–03 and at the University of Michigan from 1905 to 1915. He has been associated with the United States Bureau of Mines since 1913, first as chemist in radioactivity and since 1918 as physical chemist. He was chief chemist of the bureau from 1923 to 1925 and associate director of the Fixed Nitrogen Research Laboratory, Washington, D. C., in 1925–26. Before becoming dean of the Institute of Technology in 1935, he was director of its School of Chemistry for nine years.

Three directors and four councilors-at-large have been elected as follows:

Directors

Dr. E. R. Weidlein, director of the Mellon Institute of Industrial Research, Pittsburgh, and past president of the society, elected from the third district, comprising Pennsylvania, Delaware and Ohio.

Thomas Midgley, Jr., of Worthington, Ohio, vice-president of the Ethyl Gasoline Corporation, reelected director-at-large.

Professor Arthur J. Hill, chairman of the department of chemistry of Yale University, reelected from the first district, including Connecticut, Massachusetts, Rhode Island, Maine, New Hampshire, Vermont and Canada.

Councilors-at-large

Dr. George D. Beal, assistant director of the Mellon Institute, Pittsburgh.

Dr. Henry Gilman, professor of organic chemistry at the Iowa State College.

Dr. Harry N. Holmes, head of the department of chemistry of Oberlin College.

Professor Harold C. Urey, professor of chemistry at Columbia University.

THE AMERICAN GEOGRAPHICAL SOCIETY

At the regular monthly meeting of the American Geographical Society held in the auditorium of the American Museum of Natural History, Roland L Redmond, president of the society, announced that Dr. John Kirtland Wright had been appointed director of the society. His appointment is effective immediately.

Dr. Wright graduated from Harvard College in 1913 and received the Ph.D. degree in 1922. He has been on the staff of the American Geographical Society since 1920, as librarian from 1920 to 1937 and since then as research editor. His main interests lie in the fields of historical geography, population studies and geographical bibliography, on which subjects he has published books and periodical articles. He has also edited several of the publications of the society, notably "New England's Prospect: 1933" and Dr. C. O. Paullin's monumental "Atlas of the Historical Geography of the United States," which was published *jointly with the Carnegie Institution of Washington.*

Founded in 1852, the American Geographical Society is the oldest geographical society in the United States and the leading research institution of its kind. In 1915, with a reorganization of the staff, Dr. Isaiah Bowman was appointed as the first director, a position that he held until 1935, when he assumed the presidency of the Johns Hopkins University, Baltimore. During the twenty years of Dr. Bowman's directorship the activities of the society were greatly enlarged. Many projects of research were undertaken, among them the compilation and publication of a great map of Latin America in 107 sheets (now nearing completion), as well as studies of the polar regions and of the parts of the world that are still open to pioneer settlement. Some fifty authoritative books dealing with nearly all phases of geography have been issued by the society since 1915, and the society on several occasions has been called into consultation by the Government.

Included on its council are: Isaiah Bowman, Charles R. Crane, F. Trubee Davison, Lincoln Ellsworth, John H. Finley, William Hale Harkness, H. Stuart Hotchkiss, Archer M. Huntington, Arthur Curtiss James, Wesley C. Mitchell, Frank L. Polk, William A. Rockefeller, Carl C. Shippee.

AWARD OF THE EDISON MEDAL OF THE AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS

Dr. Dugald C. Jackson, professor emeritus of electrical engineering at the Massachusetts Institute of Technology, has been awarded the 1938 Edison Medal of the American Institute of Electrical Engineers "for outstanding and inspiring leadership in engineering education and in the fields of generation and distribution of electric power." The presentation will be made on the evening of January 25, during the annual winter convention of the institute, which will be held in the Engineering Societies Building, New York.

Dr. Jackson's early engineering experience was ned as vice-president and engineer from 1887 to 889, for the Western Engineering Company at Linoln, Nebr. He was assistant chief engineer with the Sprague Electric Railway and Motor Company, New York City, from 1889 to 1891, and later was chief ngineer for the central district of the Edison General Electric Company. In 1891, he formed a consulting ngineering firm with his brother, W. B. Jackson, and also became professor of electrical engineering at the University of Wisconsin. In 1907 he was appointed professor and head of the department of electrical engineering at the Massachusetts Institute of Technology, becoming professor emeritus in 1935. He continued as senior partner of the consulting engineering firm of Jackson and Moreland, organized in 1919, until 1930.

Dr. Jackson joined the American Institute of Electrical Engineers in 1887. He has been member and chairman of many institute committees, and was vice-president, 1897–99, and president, 1910–11. He has been president of the Boston Society of Civil Engineers and of the Society for the Promotion of Engineering Education and is president of the American Institute of Consulting Engineers. He is president of the American Academy of Arts and Sciences, and was a member of the National Research Council from 1928 to 1936. He has published five books on electrical engineering and approximately 150 articles related to engineering projects and engineering education. Dr. Jackson served in France as lieutenant-colonel of engineers during the latter part of the World War, and is Chevalier of the French Legion of Honor.

The Edison Medal, founded by associates and friends of Thomas A. Edison to perpetuate his memory, is awarded annually for "meritorious achievement in electrical science, electrical engineering or the electrical arts" by a committee of twenty-four of the leading members of the American Institute of Electrical Engineers. Previous recipients have been Elihu Thomson, Frank J. Sprague, George Westinghouse, William Stanley, Charles F. Brush, Alexander Graham Bell, Nikola Tesla, John J. Carty, Benjamin G. Lamme, W. L. R. Emmet, Michael I. Pupin, Cumings C. Chesney, Robert A. Millikan, John W. Lieb, John White Howell, Harris J. Ryan, William D. Coolidge, Frank B. Jewett, Charles F. Scott, Frank Conrad, Edwin W. Rice, Jr., Bancroft Gherardi, A. E. Kennelly, Willis R. Whitney, Lewis B. Stillwell, Alex Dow and Gano Dunn.

ADDRESS OF THE PRESIDENT OF THE ROYAL SOCIETY INTRODUCING THE PILGRIM TRUST LECTURER

At a meeting of the Royal Society on December 8 held at the Royal Institution, the president of the Royal Society, Sir William Bragg, delivered the following speech preparatory to the Pilgrim Trust Lecture by Dr. Irving Langmuir. He spoke as follows:

> The principal business of this afternoon has a significance which is at once important, interesting and welcome. We are to hear an address from one of the greatest scientists of the United States, honored throughout the world. In introducing him to you I must tell you in a few words why he has come, and what his coming means to us.
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> Rather more than a year ago, Professor L. J. Henderson, of Harvard University, foreign secretary to the National Academy of Sciences of Washington, was a visitor to this country and had many meetings with fellows of our (Royal) society. At one of these meetings the suggestion was made that there would be valuable results if direct cooperation could be established between the National Academy and our society. It was thought that a first step in this direction would be made if lecturers could be interchanged between the two bodies and the countries which they represented. The Pilgrim Trust was approached, and a most generous response was made. The trust promised to give £250 guineas a year for six years in order that a good trial might be made of a suitable scheme. Finally, it was proposed that in alternate years an American scientist should be invited to England by our society, and a British scientist invited to America by the academy. The two societies gladly endorsed the proposal in October of last year. The presence of Dr. Irving Langmuir, invited by our society, is the first realization of the scheme.
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> I should explain for the benefit of some who may not be familiar with the scientific institutions of America that the National Academy occupies a foremost place in the States. It corresponds in many ways with our society. Our society is proud to be associated with an institution of such high standing; our relations with it have always been most friendly, and we are glad indeed that they are to be strengthened still further by this new bond between us.
>
> Dr. Irving Langmuir was chosen without any hesitation as the man whom we would most like to see in Britain as our first Pilgrim Trust lecturer. He has already done famous things both in pure science and its applications. No doubt there are many who know what he has done for the great illumination problems. The modern electric lamp, with its filling of gas, is largely his creation, and the electron discharge has been developed by him so as to become one of the useful tools of industry. His work on the nature, properties and handling of molecular films spread on the surfaces of liquids is admired and copied in every laboratory of distinction. He has new work on

this subject to describe to us this afternoon, work which makes a notable addition to the subject of biochemistry. We are very happy that America should spare to us for this visit a man who has done so much for the reputation of American science, and we are very ready to learn what he has to teach us.

Our society has sought to pay its respect to Langmuir's work by the award of the Hughes Medal in 1918, and by electing him as a foreign member of our body. He received the Nobel Prize for chemistry in 1932. The American Academy of Arts and Sciences gave him the Rumford Medal in 1920.

It is an interesting fact that this Rumford Medal is the parallel of our own Rumford Medal, in that the two were founded by the same great scientist. I may draw your attention to a further interesting fact, that Rumford the American was the originator of the Royal Institution where we meet to-day.

SCIENTIFIC NOTES AND NEWS

The American Association for the Advancement of Science and a large number of affiliated and associated societies are holding meetings in Richmond during the present week, under the presidency of Dr. S. A. Mitchell, professor of economics in Columbia University. A preliminary program, edited by Dr. F. R. Moulton, permanent secretary, was printed in the issue of Science for December 2. Full accounts of the meeting and a number of the more important addresses will appear subsequently. The address of the retiring president, Dr. George D. Birkhoff, will be found in the present issue.

The election of the following sectional presidents of the British Association has been announced: *Mathematical and Physical Sciences,* R. S. Whipple; *Chemistry,* Professor E. K. Rideal; *Geology,* Professor H. H. Read; *Zoology,* Professor J. Ritchie; *Geography,* A. Stevens; *Economics,* Professor H. O. Meredith; *Engineering,* H. E. Wimperis; *Anthropology,* Professor W. E. Le Gros Clark; *Physiology,* Professor D. Burns; *Psychology,* R. J. Bartlett; *Botany,* Professor D. Thoday; *Education,* Dr. A. P. M. Fleming; *Agriculture,* Sir Thomas Middleton. The annual meeting in 1939 will be held at Dundee from August 30 to September 6, under the presidency of Sir Albert Seward.

Professor D. W. Johnson, professor of physiography at Columbia University; Professor H. von Eckermann, assistant professor of mineralogy and crystallography in the University of Stockholm, and Professor A. A. Öpik, professor of geology in the University of Esthonia, have been elected foreign correspondents of the Geological Society of London. Professor Emile Argand, professor of geology, mineralogy, petrography and paleontology in the University of Neuchâtel, and Dr. E. A. Stensiö, director of the department of paleozoology in the Naturhistoriska Riksmuseum, Stockholm, have been elected foreign fellows.

Dr. H. B. Walker, of the College of Agriculture of the University of California, was awarded the John Deere Medal for 1939 of the American Society of Agricultural Engineers in recognition of his "distinguished achievement in the application of science and art to the soil" at the Chicago meeting. The me was given to the society for annual award by desc dants of John Deere, inventor of the first all-s plow. Last year for the first time it was awarde S. H. McCrory, of the U. S. Department of Agri ture. The presentation to Dr. Walker will be mad the annual meeting of the American Society of A cultural Engineers to be held at the University Minnesota next June.

At the hundred and ninety-fourth convocation the University of Chicago the honorary doctorate science was conferred on Dr. James B. Herrick, who retired in 1926 as emeritus professor of medicine of the Rush Medical College. Dr. Emmet B. Bay, dea of Rush Medical College, a former student and asso ciate, presented Dr. Herrick for the degree. Th citation read: "Scholarly teacher and devoted phys cian, whose character and attainments have adorn this university and whose contributions to knowled have enriched the annals of medical science."

The University of Paris has conferred honorar degrees on Dr. Albert von Szent-Györgyi, professo of medical chemistry in the faculty of medicine of the University of Szeged; on Dr. S. P. L. Sorenson, director of the chemical section of the Carlsberg Laboratory, Copenhagen, and on Dr. Paul Karrer, director of the Institute of Chemistry at the University of Zurich.

Trinity College, Dublin, conferred on December 8 the honorary degree of doctor of science on Dr. E. S. Goodrich, professor of zoology and comparative anatomy at the University of Oxford.

Museum News reports that the Inter-Museum Council of New York City, at a meeting of representatives of about thirty institutions held on November 4, elected Dr. Clark Wissler, of the American Museum of Natural History, *chairman;* Hardinge Scholle, Museum of the City of New York, *vice-chairman,* and Robert P. Shaw, of the New York Museum of Science and Industry, *secretary-treasurer.*

Dr. Ernest E. Tyzzer, George Fabyan professor of comparative pathology at Harvard Medical School, who succeeded Dr. Richard P. Strong when he retired last autumn as professor of tropical medicine, has been appointed head of the combined departments of tropical medicine and comparative pathology.

Dr. John C. Whitehorn, physiological chemist and director of laboratories at McLean Hospital, Belmont, Mass., has been appointed professor of psychiatry in the Washington University School of Medicine, St. Louis. The department of neuropsychiatry of the medical school has received from the Rockefeller Foundation a grant of $150,000 to assist in the development of research and teaching.

Dr. K. W. Meissner, formerly professor of physics in the University of Frankfurt-am-Main, Germany, has joined the staff of the department of physics of the Worcester Polytechnic Institute.

Dr. F. A. Paneth, reader in atomic chemistry in the University of London, has been appointed professor of chemistry at the University of Durham. He succeeds Professor Irvine Masson, who recently resigned to become vice-chancellor of the University of Sheffield.

At the Museum of Zoology of the University of Cambridge, F. T. Parrington, of Sidney Sussex College, has been appointed director. Other appointments include H. B. Cott, of Selwyn College, curator of vertebrates and Strickland curator; J. E. Smith, curator of invertebrates; Dr. G. C. Varley, of Sidney Sussex College, curator of insects. He was also appointed university demonstrator in zoology.

Miss Margaret Poor has been appointed assistant entomologist at the Bernice P. Bishop Museum, Honolulu.

Dr. John Van Oosten, in charge of Great Lakes Investigations of the U. S. Bureau of Fisheries, has become a member of the water resources committees of the National Resources Committee for the Upper Great Lakes (Superior, Michigan and Huron) and the Lake Erie basins.

Clinton G. Abbott, director of the Natural History Museum, San Diego, Calif., has been appointed a member of the State Committee of Parks, Parkways and Recreational Facilities.

Dr. John F. Cunningham, dean of the College of Agriculture of the Ohio State University, has been named chairman of the resident teaching section of the Association of Land Grant Colleges and Universities.

Dr. G. F. Loughlin, chief geologist, and L. W. Currier, geologist, of the U. S. Geological Survey, recently conferred in Boston with officials of the Massachusetts Department of Public Works in regard to the plans for an accomplishment of geologic investigations in the state that are being undertaken by the Geological Survey in cooperation with the state. These investigations include geologic mapping of various areas and the preparation of reports to state engineers on road building projects, etc.

At a meeting in Washington of the Board of Trustees of the National Geographic Society four life trustees were elected as follows: Rear Admiral L. O. Colbert, director of the Coast and Geodetic Survey; Major General Henry H. Arnold, chief of the U. S. Army Air Corps; Dr. Floyd K. Richtmyer, dean of the Graduate School of Cornell University, and Leroy A. Lincoln, president of the Metropolitan Life Insurance Company of New York.

Charles M. B. Cadwalader, president of the Academy of Natural Sciences of Philadelphia, has been elected to the board of managers of the Wistar Institute of Anatomy and Biology and to the board of trustees of the Wagner Free Institute of Science.

A Nutrition Panel, consisting of food experts and scientific men in every branch of research and industry, has been announced by the Food Group of the Society of Chemical Industry of Great Britain. The panel, with Dr. J. C. Drummond, professor of biochemistry at the University of London, as chairman, and A. L. Bacharach as honorary secretary, has been formed for the study of food in relation to health and disease. Its scope will include the production, processing and distribution of food for both human and animal consumption and the manufacture and control of preparations for supplementing diets for medical use in the nutritional disorders. Regular meetings of members are being arranged and subjects to be discussed will range from vitamins to food storage in national emergency and animal nutrition.

Dr. Irving Langmuir, of the General Electric Company, who is in England to give the first lecture established by the Pilgrim Trust, gave an address before the Physical Society of London on December 20. He spoke on "The Structure of Prolan."

H. D. Miser, geologist in charge of the section of fuels, U. S. Geological Survey, delivered his presidential address as retiring president of the Geological Society of Washington on December 14. His subject was "Our Petroleum Supply."

Dr. Peter H. Buck, professor of anthropology at Yale University and director of the Bishop Museum, Honolulu, addressed students of Mills College, California, on December 14.

An inaugural lecture was given on November 28 by Professor J. D. Bernal, who was recently appointed to the university chair of physics at Birkbeck College, University of London. He spoke on "The Structure of Solids as a Link between Physics and Chemistry."

The annual conference of the British Geographical Association will be held at the London School of Economics from January 3 to 6, under the presidency of Sir Thomas Holland. The subject of Sir Thomas's address will be "The Geography of Minerals." The Institute of British Geographers will hold its annual meeting at the same time and place.

Commemorating the thirty-fifth anniversary of the first flight of the Wright Brothers at Kitty Hawk, N. C., on December 17, 1903, the New York Museum of Science and Industry, in Rockefeller Center, opened on that day a special aeronautical exhibition with the emphasis on flying for the civilian. Airplane models, a full-sized all-metal plane designed for the amateur flyer, together with material showing how an all-metal plane is constructed, and an exhibit of aerial cameras make up the exhibition. Among the models, which number about thirty military, naval and commercial airplanes and flying boats, is one of the original Wright planes. A model of the Wright Brothers memorial at Kitty Hawk is also shown.

A habitat group containing the world's largest gorilla was opened on December 16 in the African Hall of the Academy of Natural Sciences, Philadelphia. The group was collected and presented to the academy by George Vanderbilt, of New York, who, with Mrs. Vanderbilt, attended a private opening of his group and a dinner given in their honor by Charles M. B. Cadwalader, president of the academy.

By the will of the late Edward Benedict Cobb, Yale University receives, in addition to a bequest of $400,000, an interest in the residuary estate of $1,400,000.

Arches National Monument, Utah, one of a group known as the Southwestern National Monuments, administered by the National Park Service, has been increased in area more than six times. The extension adds four sections of much scenic value, related in geologic formation to the original area of 4,520 acres, set aside in 1929. These sections are known as the Devil's Garden, the Courthouse Towers, the "Klondike" and part of the Canyon of the Colorado River. Produced by centuries of water and wind erosion, the monument consists of a series of arches, natural bridges and windows, with balanced rocks, pinnacles and other shapes eroded from the basic red sandstone. Petrified remains of dinosaur bones have been found in the vicinity, as well as well-preserved dinosaur tracks. The canyon walls bear Indian petroglyphs, showing evidences of early Indian occupancy.

The Museum News calls attention to a recent report issued by the Dominion Bureau of Statistics of Canada enumerating 36 museums in the country with full-time staffs. Twelve of these have the full time of only one person each. Thirteen have three or more full-time staff members. The annual expenditure of these museums is estimated at $800,000 to $900,000. The average daily attendance is highest at the Royal Ontario Museum, Toronto, with 688 visitors for the five museums; Vancouver City Museum has 400; the Art Gallery of Toronto, 372; the Hudson's Bay Company exhibit at Winnipeg, 235; and the National Gallery, Ottawa, and the Chateau de Ramezay, Montreal, 200 each. A directory of all Canadian museums is included in the report.

The Rothamsted Experimental Station at Harpenden, England, the oldest agricultural research station in the world, will celebrate its centenary in 1943. To mark the occasion it has been decided to carry out plan of extension, and an appeal has been made for fund of £125,000. It is proposed that the fund should be allocated as follows: Chemical laboratory new wing, £15,000; alterations to old chemical laboratory, £3,000; equipment, £3,000; pot culture houses and accessories, £5,000; farm buildings and cottages, £4,000; forecourt, £3,000; new agricultural library, with cubicles for workers, £20,000; new building for the Imperial Bureau of Soil Science and other workers associated with oversea activities, conference hall, etc., £30,000, and additions to endowment to provide upkeep of buildings, fellowships and salary augmentations, £42,000. It is hoped that it will be possible to complete the building program in advance of the celebration in 1943.

A correspondent of the London *Times* writes that Dr. Knox Shaw, of the Radcliffe Observatory, Pretoria, has received news that the mirror of the big telescope for the observatory has been cast successfully by the Corning Glass Works, of Corning, N. Y. The work of casting began in May. The mirror has now to go to Great Britain to the telescope makers, Messrs. Howard Grubb, Parsons and Company, to be ground and polished. If all goes well the telescope may be expected to arrive in South Africa towards the middle of 1939. This is the third attempt to cast the mirror, which is 72 inches in diameter. The disk glass was originally ordered in July, 1936, but in December of that year the casting proved a failure. Another mirror was cast in June, 1937, and that also was found to be a failure in September of 1937. Until the mirror arrives in Pretoria the work of completing the observatory is held up, but everything is in readiness to accommodate the telescope.

At the autumn meeting of the Zoological Section of the South-Eastern Union of Scientific Societies held at the Zoological Society of London, Sir Edward Poulton was in the chair. Dr. Julian Huxley, F.R.S., the president of the union for 1938, introduced the program, which consisted of three biological films—*Mites and Monsters* (Strand Films), *Heredity in Animals* (G. B. Instructional) and *The Private Life of the Gannets* (London Films)—in all of which he had acted as scientific adviser. *Mites and Monsters* is designed for commercial showing, but with the aim of putting across cerain definite ideas concerning the size of animals and its limitations in different groups. *Heredity in Animals* is a purely educational film, designed to explain the elementary facts of Mendelism and selection to boys and girls in the higher classes of secondary schools, and *The Private Life of the Gannets* is a straightforward nature film, aimed simply at interesting the general public.

DISCUSSION

EVIDENCE OF THE AUSTRALOPITHECINE MAN-APES ON THE ORIGIN OF MAN

A RECENT visit to South Africa, in response to cordial invitations from Dr. Robert Broom, of the Transvaal Museum, Pretoria, and Professor Raymond A. Dart, of the Medical School of the University of the Witwatersrand, Johannesburg, was undertaken by us for the purpose of making a close study of the dentition of the Pleistocene South African man-apes described by Dart (1925)[1] and Broom (1936, 1938).[2] The full report of our results is being sent for publication by the Transvaal Museum, but in view of the exceptional importance of Dr. Broom's discoveries, the following brief note may be of interest to readers of SCIENCE.

We found that the forms called *Plesianthropus transvaalensis* and *Paranthropus robustus* by Broom displayed in their adult dentitions the following characters which are transitional or intermediate between the ape and human stages: (1) the upper and lower canine teeth, apparently in males as well as females, were of relatively small size, with low tips, and were altogether more human than ape-like; (2) the third upper and lower molars were very large, in contrast to the usually short third molars of man; (3) the second upper molar was larger than the first, as in apes; (4) the third lower molar crown pattern was evidently a derivative of the ancestral five-cusped "*Dryopithecus* pattern,"[3] but it was approaching the human "plus pattern" in the arrangement of its grooves and bore a large sixth cusp as in certain primitive men; (5) the grinding teeth when well worn acquired nearly flat occlusal surfaces as in man, whereas in apes the buccal cusps of the upper, and the lingual cusps on the lower, tooth rows, tend to remain in high relief even in well-worn specimens; (6) in the upper dental arch of *Plesianthropus,* as carefully reconstructed by us, the sides were slightly divergent posteriorly and the general effect was more human than ape-like; (7) in correlation with the small size and low crown of the upper canine, the first lower premolar had a convex buccal face and showed little or no trace of the shearing mesiobuccal face which is found in the ancestral *Dryopithecus* stock, where it sheared against the distolingual face of the tusk-like upper canine. Thus the first lower premolars in *Paranthropus* were almost human in stage.

On the whole the adult dentition of the South African Pleistocene man-apes was somewhat more human than ape-like in the small canines and premolariform first lower premolars, as well as in the flattening of the crowns of the grinding teeth by wear, in the form of the upper dental arch and in the great development of cusp 6 on the lower molars. On the other hand, it was more ape-like than human in the large size of the second and third upper and lower molars and in retaining the *Dryopithecus* pattern on all the lower molars.

The deciduous dentition, which is well preserved in the young skull of *Australopithecus africanus* Dart, is more human than ape-like in the reduction of the incisors and canines, in the advanced submolariform patterns of the upper and lower deciduous molars, in the shortness and width of the deciduous dental arches; on the other hand, the relatively huge size of its permanent upper and lower molars, together with their characteristic crown patterns, indicate that this is the young of one of the adult forms noted above and serve to mark its definitely infra-human status.

These conclusions are confirmed by the annectant characters of the braincast as recently figured by Broom. The smaller adult braincast, provisionally estimated by Broom as about 440 cc, although not as large as that of a large gorilla, is more human in general appearance. The larger braincast, estimated by Broom at about 600 cc, is not unlike that of *Pithecanthropus erectus*, but definitely smaller.[4]

In 1926 H. H. Wilder, in his excellent book, "The Pedigree of the Human Race," took the bold step of uniting apes and men in a single zoological family, the Hominidae. If mice rather than men were being classified, this would have been widely recognized as a genuine discovery, in line with the more fundamental one by Linnaeus that man is a member of the natural order Primates. But most of the clergy, innumerable educators and a vast majority of the laity can not stomach the Linnaean classification because it brackets with the "brute beasts" that self-conscious and conceited prig who calls himself *Homo sapiens* and is fond of acting like the viceroy of God. The supposed phylogenetic isolation of man is even a favorite theme of those scientists who rest their beliefs upon an uncritical acceptance of catch-words such as "polyphyletism," "parallelism," "irreversibility of evolution," and the like.

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[1] *Nature*, 115: 2884, 195–199, February 7, 1925.

[2] *Nature*, 138: 3490, 468–488, September 19, 1936; *ibid.*, 142: 3591, 377–379, August 27, 1938.

[3] William K. Gregory, 1916. *Bull Am. Mus. Nat. Hist.*, Vol. XXXV, art. 19, pp. 239–355, *Dryopithecus* pattern, pp. 293–295. Gregory and Hellman, 1926; Hellman, 1928.

[4] *Nature*, 142: 3603, 897–899, November 19, 1938.

While the myth of the Eocene dawn-man will doubtless continue to flourish, the small-brained Pleistocene man-apes of South Africa now add their mute testimony that man, like his less ambitious cousins, the modern anthropoid apes, is a descendant of the late Tertiary dryopithecine ape stock of Europe, Asia and Africa, and that, as long maintained by us and more recently supported by Davidson Black, Weinert and Broom, the human status was gained through a long-continued and profound morphological revolution during the Pliocene and early Pleistocene epochs.

William K. Gregory
Milo Hellman

American Museum of
Natural History

SOME NOTES ON THE NEW ENGLAND HURRICANE OF 1938, MADE AT WORCESTER, MASS.

The hurricane arrived so inconspicuously that hardly any one noticed its arrival. The Weather Bureau forecast in the papers sold on the street up to the time of the storm made no suggestion that anything unusual might occur. The wind was blowing hard in the middle of the afternoon, but no one thought anything of that. There were none of the ordinary signs of storm, no heavy black clouds, no suggestion of lightning. Instead, the wind came from slightly east of south, a direction from which we usually get mild weather, and the sky was overcast with a feeble attempt at rain.

The first, within my personal contacts, to recognize danger was our family cat. Previously she had insisted that her family be kept upstairs, but as the storm approached she came down the stairs with a kitten in her mouth, hid it under the couch while she went to the cellar to find a better refuge for her family.

The wind continued to increase, but no one thought anything of that. The clouds started to break up and the rain practically stopped. Now we could see two distinct layers of clouds, a high layer which appeared stationary, and a very low layer of light fleecy clouds moving rapidly from a little east of south. If the light fleecy clouds were near the top of the hurricane layer, as we would expect, it would suggest that the storm was confined to a very thin layer of air, compared to most storms.

Next we saw workmen on the roof of a nearby factory building, trying to fasten down the roof covering, which was working loose. But the attempt was soon abandoned, and we saw the roofing paper torn loose and blown away. Still I thought nothing of the severity of the storm. With no signs of storm present except the severity of the wind, how could it be anything unusual? I wondered at the weakness of construction, how people could be so careless as to put on a roof covering in such a way that the wind could blow it off. Next we saw the edging of the roof rise and fall with each gust of wind, like a wave a few inches high running the full length of the building, and I wondered what kind of trimming this could be. It was not till this had been going on for a half hour or longer that it rose higher than usual, and I noticed that it was the entire roof, leaving the brick wall standing alone. Finally, after the wind appeared to be diminishing, the brick wall in one section gave way under the repeated hammering, buckling slowly, as it seemed, letting the roof beams fall to the floor below. The worst of the storm was now passed, and the wind was insufficient to cause further damage.

At the height of the storm closing time came at our factory. For some time, no effort had been made to keep any one at work, but most of the employees made an attempt at work between the intermissions at the windows. Now the employees, all young men, cleaned up and left for home as usual. The sensible thing to have done was to have stayed in a solidly built building like ours, to wait for the fury of the storm to pass, but not one of my employees did so. Whenever we looked there were people on foot and in automobiles making what progress they could, with bricks, signs and roofing materials falling on all sides. Probably the most astonishing thing about the storm in Worcester was that not a single person was killed by falling or blowing materials. Automobiles were demolished, but the people escaped.

I saw one building damaged, and further off two others appeared to have suffered. Others saw trees near them fall. But most of us thought that we saw some local trouble, that we had seen a piece of faulty construction, or a few trees weakened without our knowledge of it. It was not till after the storm, when I walked through a mile of continuous destruction, with hardly a hundred feet of open sidewalk at any point in that distance, that I began to realize the extent of the damage. Not until several days later did I realize that practically every building in the city was damaged to some extent, that church spires that looked sound were so weakened that it was decided to take them down rather than to repair. Not for a week did I dis-over that over our own building, which stood so solidly, with hardly a quiver from the wind, the roof was beginning to weaken. There was enough motion to start some of the joints, and several planks were noticeably loose.

Examination of the damage showed conclusively that it was not the force of the wind that alone caused the damage. Most of the buildings would have stood a considerably harder blow, if that was all. It was the continued motion that gradually loosened the joints and weakened the structures. It was the same with the trees. The motion pulled the roots up gradually, and after the storm many trees left standing were two or more inches higher at the base of the trunk than before. Often the roots at one side of the tree had been raised four to eight inches, letting the tree incline, but leaving it still solidly planted.

The storm was now practically over, but the wind, as closely as we could tell without instruments, was in the same direction. At the very center of the storm it was a straight blow, but we heard later that there had been a center of rotation a hundred miles or so west of the center of the storm, that at the center of rotation the damage was comparatively slight. If we look at the storm in the customary way, as a rotating mass of air, it is evident that some force must accelerate the air from nearly at rest to hurricane velocity and then almost stop it in each revolution. That must have been a great force, but what is its nature? How could a force be applied edgewise, that is, in a horizontal direction without causing the thin layer of air to buckle upwards? I will mention again that one of the most conspicuous features of the storm was its thinness, as indicated by the clouds, and not once did I notice a break in the uniform flow of light fleecy clouds. The traditional comparison with water flowing from a drain in the bottom of a wash basin was clearly not valid. A better comparison would be that of a thin layer of water, perhaps one-eighth inch thick, rotating at the bottom of the basin, while all the water above remained undisturbed, a thing which we never observe.

It appeared more like a mass of air from above, rolling down on the lower layers and squeezing them out. If that was the case, the observed rotation must have been only a secondary effect, an eddy at the side of the main storm, as it appeared to be. But if the wind velocity was the result of pressure from above, why the low barometer? Pressure would be expected to result in a high barometer. It suggests the familiar paradox of the flow of water in pipes, where reducing the size of pipe with a constant flow of water decreases the pressure also. It is the principle used in one form of vacuum pump, where, by making a hole in the side of the pipe where the diameter is smallest, suction is produced. Can a condition of this kind exist in the air, where a pressure from above is not transmitted to the ground, but acts in such a way as to reduce the size of the channel through which the air is flowing, with a resulting reduction in pressure?

A. W. FORBES

WORCESTER, MASS.

OHIO PRO-GLACIAL LAKES

IN 1908[1] and 1914,[2] the author published notes on lake beds in central Ohio. Four beds were called Finger Lakes of Ohio and described as well as possible, after the reconnaissance survey then made. One of these was reported to have tilted shorelines. Both the presence of the lakes and the tilt were discredited at the time by other workers and the author subsided, not because of any doubt about his findings, but because of lack of time in the pressure of other work to go over the field in a more thorough way. The recent gift of retirement from active teaching granted by the generous provision of Oberlin College has made the necessary time available, and during the past summer eight to nine weeks has been given to intensive field studies by the author, assisted by a graduate student.

During the last twenty-five years a lookout for more lake beds has been maintained, and the studies carried on this summer have covered ten abandoned lake beds; five or six more are known, and their study is booked for next summer. One of the ten examined was not wholly finished.

The findings have some considerable geomorphologic interest and a little economic value. Speaking of the possible resources first we can report that silts are found in all lake beds. Several deposits are being worked for the manufacture of tile and brick. Clays were also found in several lake beds, but in only one is any industrial use made of the clay. Gravels and sands as beach deposits are scarce and have little value, but three deltas, large for such lakes, are known; all are opened for road material. Specific shoreline features are usually wanting around the borders of the lakes.

Of value in studies in American epirogeny is the complete confirmation of tilting described twenty-four years ago in Lake Craigton. It is now known that Lake Craigton is much larger than was claimed in the preliminary survey and report, and that the tilting amounts to eighty feet in eighteen-nineteen miles along a N–S axis. This lake has three arms, one northwest toward Ashland, one north toward West Salem, and the third south toward Big Prairie. The north arm is lifted up more than the northwestern arm, hence the maximum tilt is up in the northeast. Two other lake beds have length enough in this direction to show tilting.

[1] *Am. Jour. Sci.*, 25: 239–243, 1908.

[2] SCIENCE, 39: 470, March 27, 1914; *Am. Jour. Sci.*, 37: 444–450, May, 1914.

Two of the lakes were held in on one side for a time by the continental ice, in one case for a time long enough to permit building of a large subaqueous moraine.

These lake beds are all 200 feet or more above the Maumee Beach of the proglacial lake in the Erie basin, and are in no way related to that lake. But their til ing carries the continental uplift thirty to forty mi farther south than the Maumee Beach and that much beyond any known tilt of the Great Lakes area.

GEORGE D. HUBBARD

OBERLIN COLLEGE

SUMMARY STATEMENT OF THE ACTIVITIES OF THE NATIONAL RESEARCH COUNCIL, 1937–1938

II

DENSITY CURRENTS

With the large number of power and storage reservoirs which have been constructed throughout the country in recent years a new problem of hydrodynamics has come to be recognized in the frequent occurrence in these reservoirs of streams or layers of water of a density or turbidity different from that of the surrounding body. The density of incoming waters varies with the salt content, with the temperature and with the burden of fine silt held in suspension. Currents of incoming water may move through a reservoir from entrance to exit without losing their identity by mixture with surrounding water. At other times turbulence causes a general or partial mixing. The problem consists of ascertaining the conditions which may cause or impede the general mixing of waters. It relates not only to waters in reservoirs and lakes but also to water at the confluence of rivers and to the meeting of fresh water with tide water. Among the practical applications of the problem are the determination of the quality of the waters impounded and likely to be delivered to the communities served by irrigation or urban water supply systems and estimates of the rate of filling of these reservoirs by the deposition of silt. An interdivisional committee has been appointed under the auspices of the Division of Geology and Geography to coordinate field observations which have been undertaken by several government agencies, including measurements in a number of reservoirs and natural lakes, such as Lake Mead on the Colorado River, Elephant Butte Reservoir in New Mexico, and several storage lakes in the Tennessee Valley.

RESEARCH IN PROBLEMS OF SEX

The Committee for Research in Problems of Sex has been enabled to continue its work for a period now of over sixteen years, supported by funds provided in the earlier years by Mr. John D. Rockefeller, Jr., and later by the Rockefeller Foundation. There seems to be no doubt that a large part of the advancement of knowledge that has been achieved in this field in the United States is due directly to the continued financial support with which the committee has been provided for this purpose and to the stimulating effect upon these researches which integration of interest within this field has effected. At the beginning of the committee's work, in 1922, the subject of the sex hormones was presented for special support because but little was then known concerning hormones in general or the sex hormones in particular. This subject later became a major part of the committee's program. With the large expansion of the field of endocrinology, however, the committee has turned its resources to the neuro-physiological and psychobiological problems of sex under the policy of applying its resources to the less well-developed aspects of the general subject rather than to those in which strong momentum has been acquired. Moreover, the support of a number of investigations initiated by the committee has been taken over by other agencies, giving the committee latitude for the development of new projects. The committee is able to give support to the work of fifteen or twenty collaborators annually, who are located at strong centers about the country for physiological and psychological research.

ENDOCRINOLOGY

A program similar to that for research in problems of sex was set up last year for research in the general field of endocrinology, with attention to the more general metabolic processes, and the relationships of endocrine secretions to aging and to tumorous growths and other hormonal influences. The program is carried on with the cooperation of over twenty-five collaborators in various institutions. It was selected for support by the John and Mary R. Markle Foundation, after careful study of many opportunities, as one of the most useful fields of science to which the Foundation might give aid.

NARCOTICS RESEARCH

The Committee on Drug Addiction, which is concerned with investigations upon the chemistry and pharmacology of narcotic drugs, supported by the Rockefeller Foundation, has prepared a résumé of its work during the past seven years. The committee has an interesting record of exploration into an unknown field, involving the setting up of research establishments competent to deal with the several aspects of the total problem; the contribution of much new knowledge upon the chemistry and pharmacology of narcotic alkaloids; the development of a large number of new alkaloid substances and the determination of their properties; the testing of the clinical characteristics of certain of the more promising of these substances; the devising of channels for the control of these products in the United States and abroad by taking advantage, under new relationships, of the existing patent laws and other facilities; and effecting the cooperation of a large number of individual scientists and physicians and of different types of agencies, educational, industrial and governmental. The report upon the work of this committee will be published this winter as Supplement 138, of the Public Health Reports.

RADIATION RESEARCH

The program for the study of the biological effects of various types of physical radiation, which the Council has sponsored for the past eight years, is to be continued during the current year. These investigations have been supported by funds provided by the Rockefeller Foundation and by the loan or donation of apparatus and materials by manufacturing concerns. Some twenty-seven investigators are now collaborating in this program, located at twenty-four institutions.

In the early years of this project the grants assigned were in the fields of cytology, genetics and growth and development. In more recent years emphasis in the program has been placed upon quantitative studies and on the mechanism of the effects of radiation. Due to the generous provision of apparatus and materials by manufacturers, it has not been necessary for the Council's Committee on Radiation to allot more than a small proportion of its grants in any one year for the development of apparatus.

Among the problems in this field the mechanism of photosynthesis is perhaps attracting the greatest attention. Other problems on the horizon relate to the influence of radiation as a factor of association upon the hormones of green plants, to the photochemical effects of polarized light, the effects of simultaneous or successive exposure to different wave-lengths of light, and the use of radioactive salts as tracer substances in studies of metabolism. In the development of apparatus the availability of high electric voltages and of fast neutrons are important contributions for biological experimentation.

AEROBIOLOGY

During the past year the Council's Division of Biology and Agriculture has aided in the development of studies of aerobiology, directed particularly to the occurrence in the upper air of microorganisms, bacteria, viruses, pollen, plant spores and other organic as well as inorganic dusts, and the transportation of these minute particles with air movements. The subject relates not only to the distribution of human, plant and animal diseases, such as the hay fevers and certain wide-spread infections of field crops, but also to the spread of the fungi of industry, both useful and harmful varieties, to problems of economic entomology and of plant breeding and various aspects of plant and animal dispersion. Not of least importance among the applications of knowledge of the biology of the upper air is the utilization of air-borne substance as indicators of air movements.

The project was particularly the creation of Mr. Fred C. Meier, of the U. S. Department of Agriculture. The convincing unfolding of the possibilities for valuable investigations in this newly recognized field, made accessible only comparatively recently by the airplane, was due to Mr. Meier's penetrating vision and courageous enthusiasm. The work commanded the strong interest of the Carnegie Corporation of New York and of the Department of Agriculture, both of which engaged jointly in support of an exploratory program. It is with the deepest regret that record is made of the untimely death of Mr. Meier, and of his colleague in these studies, Dean E. B. McKinley, of the George Washington University Medical School, with the unfortunate loss of the Hawaii Clipper between Guam and Manila on July 29 last, on a journey undertaken in the interests of this project. The loss of these leaders is a heavy sacrifice to science and a very great set-back to the development of a program of research upon this important subject.

JOURNAL OF PSYCHOSOMATIC MEDICINE

Among the subjects for research emerging from the series of conferences which were held last year upon borderland problems in the life sciences were the cause of neuroses in human beings and the influence of these disturbances on behavior of the individual and of groups. A favorable approach to this field of research seems to lie through the study of experimentally produced neuroses in animals, and a committee has been appointed by the Council to develop and coordinate investigation in this field. A number of groups of problems of human neuroses can be recognized, relating to the neuropathological effects of drugs, to the influence of hormones and hormonal sex factors, to early trends of personality in children, frustration studies and conclusions to be derived from psychoanalysis.

In order to provide an outlet for contributions in the field of experimental psychology dealing with neuroses and psychiatry, this committee is establishing a quarterly journal to be called *Psychosomatic Medicine,* the first issue of which is scheduled to appear in January, 1939. The journal is to be supported in its initial stages by a grant from the Josiah Macy, Jr. Foundation. It is the purpose of the journal "to bring together studies which will contribute to the understanding of the organism as a whole in both somatic and psychological aspects." The journal will be in charge of an editorial board representing psychology (in general), neurology, psychiatry, psychoanalysis, comparative physiology, internal medicine and pediatrics, and its scope will comprise these and related fields.

INTERNATIONAL SCIENTIFIC CONGRESSES

The National Research Council appointed representatives for the following international scientific congresses this year:

XIIIth Conference of the International Union of Chemistry, and the Xth International Congress of Pure and Applied Chemistry, Rome, May 15–21, 1938; 15 representatives.

XVth International Geographical Congress, and the 6th General Assembly of the International Geographical Union, Amsterdam, July 18–28, 1938; 7 representatives.

VIth General Assembly of the International Astronomical Union, Stockholm, August 3–10, 1938; 6 representatives.

VIth General Assembly of the International Scientific Radio Union, Venice, September 5–25, 1938; 5 representatives.

In addition a considerable number of other American scientists attended these meetings.

PUBLICATIONS

Among publications of the Council during the year may be mentioned:

An "International Directory of Anthropologists," which lists about 1,950 names, of whom some 600 are from the United States (mimeographed).

A treatise upon "Measurement of Radiant Energy" and a "Glossary of Physical Terms," sponsored by the Council and published commercially by the authors in the latter part of 1937.

"An Experimental Study of the Problem of Mitogenetic Radiation," issued under auspices of the Committee on Radiation. (N.R.C. *Bulletin* No. 100; July, 1937.)

The preparation of the third edition of the "Handbook of Scientific and Technical Societies of the United States and Canada," the Canadian section having been compiled by the Canadian National Research Council. (N.R.C. *Bulletin* No. 101; October, 1937.)

The "Third Report of the Committee on Photochemistry," critically summarizing contributions in this field during the seven years since the issuing of the Second Report of this Committee. (Published in the *Journal of Physical Chemistry,* Vol. 42, pages 699–854, June, 1938; and in the N.R.C. *Reprint and Circular Series,* No. 108, July, 1938).

ROSS G. HARRISON,
Chairman
ALBERT L. BARROWS,
Executive Secretary

SPECIAL ARTICLES

ANTI-CATALASE AND THE MECHANISM OF SULFANILAMIDE ACTION

HEALTHY, normal rabbits fed sulfanilamide in adequate dosage survive intradermal infection with type I pneumococcus in greater number than rabbits not so benefited.[1] Blood taken from the rabbit during the period of conferred increase in capacity for resistance has a comparably increased capacity for retarding proliferation of type I pneumococcus *in vitro.*[2] The increase is, possibly, accomplished in an indirect way: the actual checking agent being, not sulfanilamide itself, but hydrogen peroxide.

The pneumococcus and the hemolytic streptococcus have the property of being able to produce peroxide without, at the same time, being able to prevent peroxide accumulation.[3] Both are sensitive to peroxide injury and depend for peroxide elimination on catalase borrowed from the medium supporting growth. Catalases decompose peroxide and permit growth so long as they remain efficient. They are inactivated by hydroxylamine[4] and by substances related to hydroxylamine in structure or properties.[5,6]

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[1] A. Locke, R. B. Locke, R. J. Bragdon and R. R. Mellon, SCIENCE, 86: 228, 1937.

[2] A. Locke, E. R. Main and R. R. Mellon, *in preparation.*

[3] J. W. McLeod and J. Gordon, *Jour. Path. Bact.,* 26: 326, 1923.

[4] H. Blaschko, *Biochem. Jour.,* 29: 2302, 1935.

[5] D. Keilin and E. F. Hartree, *Nature,* 134: 933, 1934.

[6] M. G. Sevag and L. Maiweg, *Biochem. Ztschr.,* 288: 41, 1936.

Substances analogous to hydroxylamine in anti-catalase effect are produced from sulfanilamide when dilute solutions of the drug are exposed to ultraviolet radiation.[3] They should be as easily produced from sulfanilamide by peroxide-producing pneumo- and strepto-cocci, through equivalent processes of oxidative disintegration, producing an amount of anti-catalase, within the multiplying organisms, sufficient to permit accumulation of hydrogen peroxide to levels forcing change in growth rate or growth character.

The retarding effect of sulfanilamide on pneumococcal and streptococcal proliferation is not manifested until after a lag[7] possibly required for the preliminary period of absorption and oxidation, and subsequent hydrogen peroxide accumulation, above postulated. Blockade of the p-amino group, in sulfanilamide, through acetylation, produces a degree of impairment in effectiveness[8] parallel to the degree of impairment susceptibility to oxidation effected. Oxidation of e p-amino group to a p-hydroxylamino grouping is ported to produce an increase in ability to check eptococcal proliferation *in vitro* not elicited follow- more drastic oxidation to the p-nitroso or p-nitro uping.[9]

he effectiveness of sulfanilamide for producing ardation of streptococcal proliferation, *in vitro*, is reased following dilution of the growth medium with ine,[8] to an extent parallelling the diminution in alase concentration produced. Sulfanilamide has peared to be appreciably more effective, *in vivo*, in omplishing sterilization of the catalase-poor spinal fluid than in accomplishing sterilization of the catalase-laden blood.[6]

A more detailed presentation of the above-covered material has been prepared for later publication as a part of a comprehensive report on non-specific factors in resistance which may escape notice of investigators interested more directly in the mechanism of sulfanilamide action.

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THE EFFECT OF AMMONOLYZED FOODS ON THE GROWTH OF ALBINO RATS

It has been reported recently that calves can gain weight on forms of nitrogen not supposed hitherto to be digestible and assimilable by animals.[1] Much work of this kind extending back to 1919 has been done in the United States and in Germany, and it has been described in a recent review which contains an excellent bibliography.[2]

We have modified and extended such work by using albino rats instead of ruminant animals and by using liquid ammonia in place of nitrogen containing salts, although ammonium hydroxide, ammonium carbonate and ammonium citrate were used in some of the control experiments. A preliminary report concerning some of the work has been published.[3]

It had been shown previously that proteins are ammonolyzed in liquid ammonia, and thereby increase their nitrogen content.[4] Preliminary experiments showed that ammonolyzed casein caused a loss of weight in young rats when it was used to replace other proteins. In order to determine the cause of this toxic effect, a series of experimental feedings was made in which different constituents of the diet were treated with liquid ammonia or ammonium hydroxide or all the constituents of the diet were mixed with ammonium carbonate. It was found that failure to grow occurred in all cases in which the vitamin B complex in the form of dry yeast was allowed to come in contact with ammonia. However, if the yeast was supplied in a separate container, and the remaining food ammonolyzed, the rats not only showed no such interference with growth, but actually grew more rapidly than control animals on normal diets. The control and experimental animals were given their food ad libitum, except for the yeast, and ate equal amounts. The yeast when fed in separate containers was weighed each day, since it is known that vitamin B in excess will accelerate the growth of young rats. Litter mates were used with an equal distribution of males and females. The nitrogen content of the protein was increased by 2.2 per cent. by the treatment with liquid ammonia. In addition it was found that ammonolyzed food has less tendency to spoil or become mouldy than untreated foods.

Just how an albino rat can use such nitrogenous materials as food we are not prepared to say. An explanation in this case might be even more difficult than with ruminant animals, since in their case some intermediate action of bacteria is sometimes assumed.

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VITAMIN B_1 AND THE GERMINATION OF POLLEN

BEGINNING with the work of Von Mohl[1] in 1838, varying degrees of success have attended attempts to cultivate pollen *in vitro*. The culture media in most cases consisted of a mixture of sugar and agar or sugar and gelatine. A very considerable improvement in these culture media was effected by Brink,[2] who discovered that a water extract of sterile yeast added in small amounts to the sugar media stimulated pollen tube germination.

In recent years it has been found[3] that the beneficial effects of yeast extracts on the growth of excised roots *in vitro* was due in part, at least, to the vitamin B_1 content of the yeast extract. This consideration has led the writers to suspect that vitamin B_1 might be the substance in yeast extract that produced the beneficial effects observed by Brink. That this vitamin does actually accelerate germination of pollen is shown in the following experiments.

Pollen from *Carica quercifolia* and from the Orlando, Fairchild and Florida varieties of *Carica papaya* was tested for germination percentage in Van Tiegham cells, using a medium of 4 per cent. sucrose and ¾ per cent. agar with and without the addition of crystalline vitamin B_1 (0.1–200 gamma per cc). With the exception of the Orlando variety, an addition of 100 gamma B_1 per cc resulted in a significant increase in the germination percentage over that obtained without B_1 (Table 1). This increase was, however, in most instances greater during the first two hours than after a four-hour period, which suggests that the main effect of the B_1 treatment was to speed up germination. A survey of the effectiveness of various concentrations of B_1 on the germination of pollen of the Florida variety showed that a maximum response was attained with 100 gamma per cc. Some acceleration in germination over controls was obtained from 50 gamma, but 0.1, 1 and 10 gamma gave no response. This effect from such high concentrations of B_1 is interesting in view of the fact that the optimum B_1 concentration for root growth has been found to be near 0.002 gamma per cc.[3]

TABLE 1

GERMINATION OF PAPAYA POLLEN WITH AND WITHOUT TREATMENT WITH VITAMIN B_1

Variety	Length of test period Hrs.	Control Per cent. germination	Vitamin B_1* Per cent. germination	Percentage difference over controls
C. quercifolia	1	10	21	+ 110.0
	1¾	25	37	+ 48.0
	2½	31	56	+ 80.6
	4½	71	80	+ 12.6
Fairchild	1	53	67	+ 26.4
	2½	67	77	+ 14.9
	4	75	88	+ 17.3
Florida	1	25	41	+ 64.0
	2	46	80	+ 73.9
	5	85	86	+ 1.1
Orlando	¾	35	32	+ 8.5
	1¾	76	75	− 1.3
	2½	80	77	− 3.7

* 100 gamma per cc.

Vitamin B_1 has been detected by biological assay in leaves, stems, roots, fruits and seed of many plants (Summary in Sherman and Smith.[4]) Also Dutcher[5] has demonstrated the presence of vitamin B in maize pollen. It may be that germination of pollen taking place without the addition of an external supply of B_1 is caused by naturally occurring vitamin B_1 in the pollen. Further work on the physiology of vitamin B_1 and other substances in pollen germination is under way. Addition of indoleacetic acid in concentration ranging from 1/10 to 100 gamma per cc had no beneficial effect on germination of papaya pollen.

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